COMPUTERS AND AUTOMATION

CYBERNETICS • ROBOTS • AUTOMATIC CONTROL

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THE EDITOR'S NOTES

THE IRE SHOW -- FOR COMPUTER PEOPLE

We went to the Inst. of Radio Engineers' show in the Kingsbridge Armory, Bronx, N. Y. Literature for the press provided some statistics: There were nearly two miles of exhibits displayed in some 715 booths. The attendance was expected to be over 45,000 persons. The exhibitors at the convention between them produce about 80% of the country's productive output in electronics. It was a tremendous show, really "super-colossal".

The problem however that we still have not solved is how an ordinary human being can <u>see</u> the show, with a reasonable degree of mental absorption of the new ideas presented. Total time the show was open came to 43 hours over four days, or 2580 minutes. If a man set to work to <u>see</u> every single exhibit, he would have only 3½ minutes for each one of the 715 booths. We spent most of an afternoon there, and saw four or five exhibits, to the extent of really finding out something we wanted to know from what they were exhibiting.

We went to the show interested in computers, and other features closely related to computers. We thought at first that the exhibitors that had something related to computers would be on "Computer Avenue", but then we found out this was not so. But it was quite impossible to find all the computer exhibitors in the time we had.

Now the IRE Directory is well organized, so that if you want to find out something about computer organizations, you can find them all listed in the same place, together with some comments about them. Also, the IRE schedule of Technical Sessions is well organized, so that if you are interested in electronic computers, you can find just the sessions that you want to go to. So why not provide for next year's IRE show a map and guide to the exhibitors and their locations and what they have that is new — for each of the many professional interests or subfields (such as electronic computers) that the IRE serves? In this way a person interested in computers (or some other subfield) could quickly find out where are the best things to see in the time he has, with a minimum of unnecessary tripping.

WHO'S WHO IN THE COMPUTER FIELD
-- FOR THE COMPUTER DIRECTORY

Currently we are mailing out a Who's Who entry form to all computer people that we know of. The form asks for: your name? your address? your organization? its address? your title? your main computer interests? year of birth? college or last school? year entered the computer field? occupation? anything else?

On the form there is a notice as follows: The Who's Who section of the Computer Directory, which last year filled about 95 pages of the 1955 issue, has **not paid** for itself. So this year we request a nominal charge of $2.00 from each person whose entry is printed, in order to help defray the cost of the Who's Who. The main reason for this nominal charge is that we look on the Who's Who as a service to many people in the computer field, especially to employers and management advisers looking for good men; but because of the cost of the Who's Who, we have to make some kind of departure from the free printing policy which we followed in 1955. Please express your views below: ( ) I think the requested nominal charge is reasonable, and enclose my Who's Who entry and $2.00. ( ) I do not agree with the requested charge, but I enclose my Who's Who entry and $3.40 for which I order an extra 1956 directory at 15% discount (not returnable). ( ) I enclose my Who's Who entry and $______ to help defray the cost of the Who's Who. ( ) Other: ____________________. If there proves to be insufficient support for the Who's Who and we do not publish it, we shall refund the $2.00 and $3.40 payments. In any case please send us your completed 1956 Who's Who entry form.

INDEX OF NOTICES

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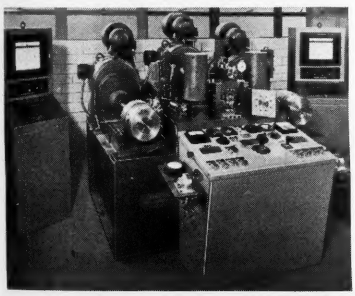

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COMPUTING MACHINES AND AUTOMATION

Testimony of
DR. A. V. ASTIN, Director,
National Bureau of Standards
before the
Subcommittee on Economic Stabilization,
Joint Committee on the Economic Report,
October 27, 1955

I am pleased to respond to the invitation of this Subcommittee to participate in the current hearings on the subject of automation. The invitation requested specifically that I discuss the experience of the National Bureau of Standards with computing machines and that I give my views on the future of office and factory automation.

Let me outline first the functions and objectives of the National Bureau of Standards in order to provide a background for our activities in this area. The National Bureau of Standards is a Federal scientific and engineering institution, established to provide unique and essential services to science, industry and Government. Our most basic function is to provide standards for physical measurement, together with means for their effective use. This responsibility requires unusual competence in the science of physical measurement in all major branches of science and engineering.

Because of the general competence of our organization on problems of physical measurement, it has been customary for other Government agencies to seek advice and assistance from the Bureau on scientific and technical matters. With the rapidly growing importance of technology in our national economy, this service function of the Bureau to other Government agencies has increased. At present approximately two-thirds of the Bureau's total program is devoted to projects requested and paid for by other agencies of the Federal Government.

The Bureau's work on automatic electronic computing machines began as a part of the organization's technical assistance program. In 1946 requests for such assistance came from three different sources: The Bureau of the Census, the Office of the Air Comptroller, and the Office of the Chief of Ordnance. The Bureau of the Census was exploring the possibilities of applying recent advances in electronics to their large data-processing problems. A preliminary survey showed that the prospects were very good. This was followed by a contract placed by NBS with the former Eckert-Mauchley Corporation to prepare detailed performance specifications for a machine suitable for the needs of the Bureau of the Census. The completion of this contract was followed, in turn, by a purchase order placed by NBS for three large electronic data-processing machines: one for the Bureau of the Census, one for the Office of the Air Comptroller, and one for the Army Map Service. This order was filled by the delivery of the first three UNIVACS.

The problem brought to the Bureau in 1946 by the Office of the Air Comptroller required the services of both electronics and mathematical experts from the Bureau's staff in connection with logistics planning problems of the Air Force. A preliminary analysis of these requirements pointed to the desirability of having available at an earlier date a somewhat more modest computing machine than the expected UNIVAC. This led to the design and development by the Bureau of its Standards Electronic Automatic Computer, commonly known as the SEAC. The SEAC was placed in productive operation almost a full year before the first UNIVAC was delivered, and it has now been operating on an around-the-clock basis for more than five years.

Also in 1946, the Office of the Chief of Ordnance asked the Bureau to study critical components and subassemblies for a data-processing machine which the Army was procuring for its Ballistics Research Laboratory at Aberdeen, Maryland. This led to an active program at the Bureau on the development of materials and components for use in the computing machine field and to the development of reliable evaluation techniques for such components.

A little later the Bureau designed and built for the Department of Defense a mobile and more advanced machine, the DYSEAC. The DYSEAC was turned over to the Department of Defense in the Spring of 1954 and is now in operation at the White Sands, New Mexico Proving Grounds. The availability of the SEAC coupled with the Bureau's considerable experience in this rapidly growing field has resulted in numerous requests for technical advice and assistance in connection with the design and possible utilization of modern, high-speed, electronic computing devices. Before discussing more specifically the nature and importance of some of these requests, I should like to outline some of my own views concerning the importance of these new technological developments to our national economy and to our general welfare. The relationship of these developments to our economy is, I believe, closely associated with the interest of this Subcommittee in the field

of automation.

Automation is a relatively new word. It has been defined in many ways by various people. It probably means, the process of rendering automatic. From this point of view, the newest thing about automation is the word itself. The development of devices to perform functions automatically is a very old activity. For example, the ancient Romans invented a hydraulic float valve to control automatically the level of water in storage tanks. I would prefer to consider the subject of mechanization which is a broader area of technology, with automation as one of its important subdivisions. The general goal of mechanization is increased productivity: to use machines to aid man in producing more goods and services. Increased mechanization and increased productivity have expanded together. This has been especially noteworthy over the past 150 years and particularly in the past 50 years.

Mechanization has several important phases: The first and probably the most basic is the replacement of physical energy provided by humans or animals by energy provided by machines powered from mechanical, electrical or chemical sources. A primitive example is the use of hydraulic energy to operate a flour mill. More recent examples are the use of gasoline to propel automobiles and tractors and electrical energy to turn the wheels of factories. The importance of this phase of mechanization is attested by the tremendous expansion of electrical and petroleum energy sources in recent decades. Even more phenomenal expansion can be expected as atomic energy sources become available.

A second phase of mechanization is the use of physical measurement. In the older days of hand craftsmanship, items were fabricated by fitting mating parts together or by adjusting an item, such as a garment, to the individual size of the user. With the development of the science of measurement, together with instruments for making measurements, it became possible to fabricate items according to specification. When items are fabricated according to physical characteristics, as defined on a blueprint or specification, they can be used interchangeably. Developments along these lines led to mass production techniques, the essence of which is interchangeability of parts. One of the first persons to demonstrate this technique was Eli Whitney who showed approximately 150 years ago that rifles could be assembled from interchangeable parts, each one of which was fabricated in accordance with carefully prescribed procedures of measurement. More recent advances in the science of physical measurement have brought about instruments that make certain measurements automatically, as well as instruments which make measurements more precisely.

A third phase in mechanization is the use of mechanical handling techniques whereby materials are carried by machine from one processing station to another. The conveyor belt is probably the best known example of this phase of mechanization.

A fourth phase of mechanization involves the concept of feedback. Feedback merely means the use of the result of a physical measurement at one stage of a mechanical process to alter or control an operation at an earlier stage of the process. A commonly used example of feedback is the thermostat on an automatic furnace. The thermostat measures the temperature at a particular location and feeds the result of this measurement to the controls of the furnace, shutting it off or turning it on according to the temperature observation. Feedback can be accomplished entirely mechanically or with the intervention of human operators in varying degrees. In the furnace example, a man can be both the temperature measuring device and the feedback element: he shovels coal or closes the furnace drafts, depending on whether he is cold or hot. In steel production, it is customary to run analyses on the composition of the melts at various steps along the processing line. A human operator may make the measurements with mechanical instruments which can result in an orally conveyed order to modify a phase of the production process as a result of the measurement. In modern petroleum refining, the measuring process, the order giving and the resulting control modification can all be accomplished mechanically.

A fifth and most recent phase of mechanization is the utilization of advanced and automatic computational techniques. Frequently the completion of the feedback process requires computations of varying degrees of complexity on the results of a physical measurement before a proper control order can be determined. Automatic machines which make possible rapid and reliable computations provide extremely important supplements to the feedback process. It is in this area that the striking recent advances have taken place, providing a basis for extensive future developments. Advances in the tools of computation have another important implication. Hitherto the trend in mechanization has been confined primarily to the processing of physical materials and devices. Automatic computing machines are, on the other hand, concerned with processing numbers and through them a wide variety of other types of information. The processing of numbers and information is an important operation in many activities other than production lines. Business offices such as banks, insurance companies, and retailing organizations, Government agencies and scientific laboratories are all concerned with processing numbers and information on increasingly larger scales. Hence this phase of the process of mechanization appears to have applications in many areas other that the pro-

duction processes where so much mechanization has already taken place.

I mentioned earlier that the goal of mechanization is increased productivity, and increased productivity is, I believe, an objective of primary concern to our Nation. Although I am not an economist, it is my understanding that the nature of our economic system is such that it must expand in order to remain vigorous and healthy. In an era when the opportunities for geographic expansion are almost nil, the only practicable means of expanding our economic system is through the development of new products or through the development of techniques for producing products more efficiently. Both of these depend on scientific and technological effort, involving continuing emphasis on mechanization in all of its phases.

A recent analysis by Dr. Raymond Ewell of the National Science Foundation shows that the productivity of our labor force, as a result of scientific and technological effort, has increased at a rate over 2 percent a year for the past 43 years. His analysis also shows the productivity rate to be accelerating - it was 3 percent over the past seven years. The dependence of our increasing productivity on science and technology can be further demonstrated by the fact that approximately half of our labor force is now engaged in producing or marketing materials or devices that were generally unheard of 50 years ago.

Progress in science and in industrial productivity are closely related. Advances in each of the major phases of mechanization, which make possible increased productivity, depend on progress in science and engineering.

Furthermore, the orderly advancement of science also depends upon developments in some of the same areas that are important to the growth of industrial mechanization. The science of measurement is fully as important to general scientific progress as it is to industrial progress. Better instruments and techniques of measurement aid both science and industry. Further advances in the computing machine field will likewise aid both areas. The interrelatedness of science and productivity is demonstrated by the fact that new and improved production methods make possible new and better tools - material and instruments - for the scientist, enhancing his opportunities for discovery.

I have stressed this interrelatedness because it is important to appreciate that progress in all phases of science and technology contribute to increasing productivity, which is essential to a vigorous economy and a strong Nation.

An important characteristic of an expanding economy, dealing with new products and new techniques, is that it must be accompanied by an expanding science. New problems must be solved which are always larger and more complex. It is in coping with such a situation that the new automatic computing machines assume major significance. Many of the scientific and technological advances which have been made with the use of these machines would have been either impossible or excessively costly to achieve without them. Modern guided missiles and the hydrogen bomb provide two outstanding examples. To date, our experience with these machines shows that they are not used primarily to do old work with fewer people. Instead we are tackling the important new problem with the same or even more people, thus increasing our capacity to explore the unknown. Viewed in this light, the recent developments with computing machines help to fulfill the current need of science and technology. Advances have now reached a stage where further progress would be impracticable or uneconomical without them.

The utilization of modern high-speed computing machines has, so far, been mainly in the field of science and technology, especially in those areas important to our defense effort. It is extremely likely, however, that their ultimate major use will be in the field of office operations for both government and business. In this area, we now find a situation somewhat analogous to the state of scientific technology before the advent of these machines. Office operating problems have reached a size and complexity that can fast become a barrier to further efficiency and growth unless there is provided better means for handling the masses of information which clog modern offices.

This situation has been very well described by former Assistant Secretary of Commerce James C. Worthy. I should like to quote from one of his talks:

"...It is a fact of great significance that the number of clerical workers has increased more rapidly than the number of productive workers during the past half century. Modern productive techniques, with their consequent centralization of direction and control, require increasingly greater proportions of paper-processing personnel.... Unless current trends can be halted or reversed, an ever larger and larger portion of the nation's total manpower will necessarily be absorbed in unproductive record-keeping overhead at the expense of wealth-creating effort.

"The technological response to the current challenge is already clearly indicated. The development and refinement of electronic data-processing systems offers the same possibilities to business that it does to science and to government. And the end results can be similar: a greater concentration of available human resources on the production of tangible goods and services and a smaller proportionate loss to non-productive overhead.

"As in the case of government personnel, this development will not lead to large-scale displacement of employees. The process will

be gradual and permit ample opportunity for orderly adjustment. Over the long pull, it will result in the gradual diminution of monotonous, repetitive paper-handling work. At the same time, it will gradually increase the opportunities for interesting, creative high-skilled technical assignments. The consequence will be not only greater gains but higher human satisfactions.

"The consequences for management are equally significant. One of management's greatest problems is that of securing adequate and timely information on which to base day-to-day decisions. The complexity of modern business organizations has created chains of command that often isolate the decision-making group at the top from the basic facts which are essential for effective, timely control. Paradoxically, it is also true that top management may be literally swamped with undigested facts and with figures too voluminous to use. One of the important gains from the new electronic techniques will be the bringing of the right facts to the right people at the right time.

...

"Every day, new and divergent facts develop which those in responsible positions in government and industry must carefully consider and analyze. These mountains of data will surely overwhelm us if we continue to follow the practices of those who lived in a simpler time. The electronic computers with their remarkable ability to assimilate and store information for rapid selection and access may be a primary factor for sound, wise public and business policies in the troubled years ahead."

Our Federal Government has the largest office operations in the world. Hence, it seems logical that if modern data-processing machines have a place in improving the efficiency of large-scale office operations, there should be numerous possible applications within the Federal Government. Our experience has shown that this prospect is indeed very good.

The advisory and consulting services of the National Bureau of Standards have led to a need for keeping abreast of all major developments involving data processing and information handling systems. This experience has enabled me to provide a brief summary of the "state of the art" for its possible interest to the members of this Subcommittee. It is included as an appendix to my prepared statement.

Bureau of the Census

I mentioned earlier that our first activity with modern computing machines was in assisting the Bureau of the Census. Census Director Robert W. Burgess has already told you of their experience with computing machines so there is no need for me to discuss that phase of our work. There was, however, a related development for Census that should be mentioned briefly. This development involved automatic means for translating the data on the record sheets of Census enumerators into a form that could be fed directly into their computing machines.

The machine we developed has been named FOSDIC (Film Optical Sensing Device for Input to Computers). The machine reads marks on microfilmed copies of documents that have been marked with an ordinary pencil or pen, and then processes the information into electrical pulses which are recorded on magnetic tape for direct input to an electronic computer such as the Census UNIVAC. FOSDIC is designed to reduce the work that is now involved in converting written records into a medium acceptable as input by data-processing machines. This is particularly true since FOSDIC allows considerable freedom in design of the documents and does not require the use of any special writing instrument.

It is anticipated that ultimately the use of this machine will reduce appreciably the massive amount of paperwork entailed in summarizing Census information on the entire population. Although designed for census operations, FOSDIC may be generally applied to the processing of other types of information that must be handled in large quantities.

With the development of many large-scale electronic computers in the past few years, there has been an increasing need for equipment to bridge the gap between the machines and their sources of information. This is especially true for computing systems which perform relatively little computation on a large mass of data obtained from many sources. Considerable attention has been given to computers and their input-output equipment but relatively little to "pre-input" apparatus or instrumentation permitting the computer to have direct contact with sources of information. When human beings are considered as sources of information, only two partially automatic means of communication are in general use. These are (1) typewriters of various forms and (2) special marking instruments such as punches or conductive pencils. An alternate method is through the manual preparation of punched cards. To these methods has now been added FOSDIC, a completely automatic machine which processes marks made by an ordinary pencil or pen into a form directly usable by the computer.

Patent Office

Another unit of the Department of Commerce, the Patent Office, has a particularly challenging problem in the area of possible mechanization of patent search. Our patent system is closely related to the industrial growth and prosperity of the United States. It plays a major role in the creation of new products and processes, yet our patent system is

at a crossroads because of the very increasing complexity in the continued program of inventiveness. The present patent examiners are as dedicated and competent as their predecessors, but they face a task that is infinitely more complex than that of even a few decades back. The unprecedented pace of science and technology is producing new facts and inventions at a rate beyond the capacity for patent claim handling procedures which have been developed over the years so that the present staff is unable to keep the size of the backlog of patent applications from steadily increasing. In awareness of this problem, the Senate Appropriations Committee specifically directed the Department of Commerce to make an aggressive investigation of the possibility of mechanizing patent search operations. In accordance with this mandate, a committee, headed by Dr. Vannevar Bush, was appointed. This committee concluded that if the patent system is to continue to make its contribution to our expanding economy, mechanization of the routine aspects of the patent search process is essential, and that the automatic data processing art has reached a stage of development which makes feasible its application to this complex problem. Accordingly, the Patent Office and the National Bureau of Standards are cooperating in a joint program of research and development to adapt machine techniques to these Patent Office operations.

Army Quartermaster

Our work for the Army Quartermaster Corps gave us experience in coping with the problems of Government purchase and procurement.

In carrying out provisions of the Armed Services Procurement Act of 1947, a number of complications arise in determining the bidder or combination of bidders who will charge the true lowest cost to Government. True costs require consideration of different freight rates from factories to depots. The bidder himself may state restrictive provisions such as minimum and maximum quantities, or "block" or "hinge" bids whereby he may quote different prices on different quantities.

The attempted resolution of lowest cost for bids on contracts involving a variety of complicating factors, when carried out by manual methods, results in high cost both in time and manpower. On one typical operation, 700 man-hours were expended without trying all the possible combinations, and it was estimated that 4,000 man-hours would have been required to calculate all combinations. A second shortcoming of manual computation is that in some cases it is not possible to solve the problem at all in the time available. For example, a proposed contract for 860,000 woolen jackets to be fabricated for 13 different destinations, estimated to involve 223,000 different combinations, had to be cancelled because bids could not be evaluated by manual computations.

Accordingly, a program was established at NBS to explore the use of new mathematical techniques (called linear programming) in conjunction with the use of high-speed electronic computing equipment for the evaluation of such complicated bid patterns. The linear programming computation procedure, as coded for SEAC, is then used with data on the various bids received for each specific problem, and the machine operates on the specific problem by first assuming that an award satisfying the various restrictions will be chosen regardless of its cost. A cheaper allocation is then sought, and it is substituted for the first. The search for still cheaper allocations continues until no cheaper award can be found. For the typical problem, about two hours of SEAC computation are required before the minimum cost answer is found.

The direct savings achieved through the speed of electronic computation can be illustrated by the fact, that, for a problem that would have required 1000 man-hours of labor at a cost for manual computation of approximately $2,500, the machine could have tried all combinations in about 40 minutes at a cost of $80 or less. Direct savings are also achieved through the saving of time since bidders may limit the effective period of their bids to option periods of 20 days or less from the date of opening bids.

In summary, then, the linear programming technique makes possible the development of solutions to bid evaluation problems in less time, at less cost, and with absolute accuracy.

Veterans Administration

In an application elsewhere in government, the Veterans Administration has used computers for work in relation to actuarial tables. In this case, the David Taylor Model Basin's UNIVAC system was used to provide the actuarial tables necessary for the new Uniformed Services Survivors' Benefit program. Using conventional methods by desk calculation, this would have required an estimated 25,000 man-hours. The job actually took 1,443 man-hours. The cost by conventional means would have been in the neighborhood of $200,000; it was actually completed for about $15,000 with the UNIVAC.

In the course of the entire job, the UNIVAC computed 357,012 numbers to eight significant figures. The 1,443 man-hours used on the problem included time spent in analysis and process-charting, flow-charting, coding, preparing desk-calculated samples for checking, preparation for and operation of the machine, report writing, hand editing and checking tables, and maintenance.

The actual time spent by the UNIVAC in generating the numbers (not including checking of programs) was 41.4 hours. The total time used by the computer system was 104 hours. As a comparative figure, a few sample values

computed by hand for checking purposes required 55 man-hours.

More significantly, however, the Congress directed that this veterans' insurance program should go into effect within 60 days from the time that the Act was signed. The use of the computer made it possible to provide the necessary tables so that the program did go into effect on schedule with maximum benefit to all concerned, something that would have been impossible without the use of these new general-purpose, high-speed tools.

Navy Aviation Supply Office

The Bureau has also assisted the Navy in applying automatic techniques to its inventory-control and supply problems. The data processing application that is now in operation at the Navy's Aviation Supply Office is a good example of better use of present resources. In the Navy supply system, there are some 13 materiel control centers, called Supply Demand Control Points. These Control Points have cognizance over certain broad categories of materiel. In the case of the Aviation Supply Office, the responsibility is for aircraft, aircraft engines, and supporting spare parts and accessories. The supply replenishment actions used to be based on quarterly distribution and procurement in accordance with predicted demand determined by existing inventories and demand for a previous quarter. Under this control system, the regular quarterly actions had frequently to be supplemented by special actions prior to the next scheduled distribution in order to take care of fluctuations in actual demands. In some cases, as many as 40 percent or more of the stock transactions were interim transactions reflecting such unanticipated demands.

In an attempt to improve the control system, the Program Usage Replenishment System (PURS) technique was developed in the hope of attaining a more realistic balance between inventory levels and projected requirements based upon program plans. However, the introduction of this system for a few classes of supply items materially added to the computational workload at ASO. To extend the PURS procedure to additional classes of material required an even greater workload.

It was therefore reasonable to look toward the adoption of electronic data-processing techniques as a way of accomplishing this mission more expeditiously and more economically. The data-processing equipment that has been installed, the IBM 701 and 702, is now working on this job, so that management may more effectively control the procurement and distribution of supplies to meet requirements.

Air Materiel Command

The Air Force has had problems of computation for mobilization planning and for logistics control similar to that of the Navy's ASO. The Air Materiel Command is now using and actively exploring the further use of computers for logistics management. One of the problems they face is the development of a system which can be expanded during an emergency without requiring a greatly increased staff. The Bureau has assisted the Air Force in this program. In the first instance, the Bureau assisted in the selection and procurement of their first automatic processor for the Office of Air Comptroller. In the second instance, we are helping to assist the Air Materiel Command in training their supply and logistics personnel at various bases. The interesting aspect about this program is that GS-4 and GS-5 stock clerks are being given an opportunity to learn to carry out some of the programming operations for the computer. I have reports that they are doing quite well. I might mention here that the Bureau has now had considerable experience in training personnel to operate automatic electronic devices of this sort. I think it is one of the important values of our central computational and data-processing staff.

Public Housing Administration

The experience of the Public Housing Administration provides an example of how more effective work can be done with the use of data-processing machines. In the low rent housing program administered by the PHA it is necessary to determine eligibility for continued occupancy by auditing income and other statistical data concerning the tenants. With their present staff this can be done only on a sampling basis. As the result of an experimental trial of this audit task on SEAC, it was shown that a 100 percent audit would be possible with the same staff. In addition, the procedure can be organized so that their staff would be able to give more attention to borderline cases where careful, human judgment is required.

Future Activities

The preceding examples do not provide a complete picture. But I hope they have served to demonstrate some of the advantages to be derived from applying modern data-processing techniques to Government operations. There are, in fact, a host of applications which are now in the planning stage or, in an even greater number of cases, still uncontemplated.

In recognition of the demand for Bureau services in this field and for the increasing use of automatic devices for Government operations, the National Bureau of Standards has requested and received initial appropriations from the Congress for the construction of a pilot data-processing system. This pilot system is now in the planning stage and will take about two more years to get into operation. It will provide Government with a central facility for studying on a sample basis, as in the case of the housing report, the feasibility of various automatic systems and components for use in organizing procedures so that automatic machines can serve the particular needs of Government agencies. Since this pilot facility must be adaptable for actual sample trial runs of contemplated systems for a large

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TAPE IDENTIFICATION AND RERUN PROCEDURES FOR TAPE DATA PROCESSING SYSTEMS

LEONARD EALLSON
Remington Rand Univac
New York, N.Y.

Over the past few years the size and complexity of digital computers have greatly increased. Even the so-called small computers of today are in many ways far more complex than the most advanced computing equipment available ten years ago. From an economic viewpoint, modern large-scale data processing systems have fully justified their use in many areas of application. Many functions previously impossible are now performed daily and routinely. Other functions are now performed at a far lower cost with greater speed and accuracy than previously possible.

A comparison of data processing systems of today with those of ten years ago reveals the following differences:

1. The number of pieces of equipment has been materially reduced.
2. The complexity of an individual piece of equipment has been increased.
3. The number of people required for the data processing system to function has been reduced.
4. Many of the routine decisions that were previously made by personnel are now made by machines.

Any system, involving people or machines, is subject to breakdown and error. In the past, because of the many diffuse and varied elements in the system, it was not in general practical to rigorously systematize the procedures to be followed in the detection and correction of errors. Modern tape data processing systems do not suffer from this disadvantage. Because of the relatively high costs involved in the operation of an electronic computer and because information in the data processing system is all funneled through one piece of equipment, users of digital computers need to provide efficient methods dealing with errors if they are to get the most use out of their equipment. If they don't do this, long delays and heavy costs in the processing of data can be the consequences.

The subject can be broken down into two phases: detection of errors and the correction of errors. We shall first consider the detection of errors.

There are two possible sources of errors: (1) failure of personnel to properly follow predetermined procedures, and (2) equipment failure.

Most data processing operations involve large files of data which are stored on magnetic tapes. These tapes generally bear labels which identify their contents, for example, Master Policy File, September 18, 1955, reel No. 69. During a run, it is one of the functions of the machine operators to mount the reels of input tapes on the appropriate tape mechanism at the proper time. In addition, the operators are required to dismount the output reels and affix the correct tape label to the reel. One is by no means assured that these operations will be correctly executed every time.

Another type of error which may arise is as follows: During the reading of information into the computer a particle of dirt, or perhaps a transient error in the read circuits, may cause the information to be incorrectly transferred into the computer. This condition is detected by checking circuits in most computers today and often a re-read of the information is automatically attempted by the computer. However, if this procedure fails, the operator will attempt to repeat the read instruction from the control console after taking such measures as cleaning the reading head. In this process he is required to back-space the tape before each attempt. One is not assured that he will do this, or that he will not reverse the tape twice. Thus, there is a possibility that a block of information may be by-passed or read twice. These are typical errors that can be made by personnel operating the computer.

The second source of error which arises from equipment failure falls into two categories. These are, the transient failure which occurs erratically with a mean error-free time anywhere from half a minute to several hours, and the permanent error which comes into play during a large percentage of the time that a particular circuit element is used. The former of these, the transient error, is much more difficult to detect and therefore much more likely to propagate through the system.

Most modern computers are equipped to some extent with checking circuits. These may vary from marginal checking of information transfers

to complete checking circuits which will detect virtually all errors. Those computers which are not self-checked should have their programs include checking calculations. The nature of the checks programmed will depend upon the type of checks provided by the hardware.

Some errors, whether detected by the computer checking circuits or by programmed routines will be corrected immediately. These are not of interest here. Other errors will necessitate going back in the program or perhaps to a previous program in the system. The latter case arises, for example, when an input tape proves to be unreadable. In computers today it is possible to monitor and check information going on a tape to the point where it reaches the writing heads of the tape mechanism. However, such conditions as an undetected bad spot on the tape or the presence of dust or dirt can cause the information to be improperly recorded, making it impossible to read in future runs.

At this point, it should be noted that errors are not the only possible interruptions of a data processing run. Sometimes, it is necessary to remove a problem to make way for one of higher priority, or a special run is to be sandwiched between regularly scheduled runs. These problems are logically equivalent to the case of an error interrupting normal computer operation.

We will now consider a general re-run procedure and an associated tape identification scheme. These combined techniques may be used to restart problems.

Due to the large number of reels of tape usually present at a computer installation, it is necessary that each of the reels containing information bear an identifying label. However, labels are not a solution to the problem of identifying reels. In the first place, the labels are created by the machine operator and therefore may be in error. Secondly, the labels may come off the tape because of mishandling. It is therefore necessary to record an identification block as the first information written on a tape. This identification block should contain all the information which normally appears on the tape labels. In addition to providing a more permanent record of the contents of a reel of tape, the identification block also permits the computer to check on the manual operation of mounting tapes. Before the computer run starts processing the data on a tape, a check is made to compare the information in the identification block against the expected codes. If the information does not match, suitable print-outs can inform the operator of the necessary corrective measures to be taken.

The check to determine whether the operator has skipped or duplicated a block of information is carried out as follows: Each time an output tape is produced, the programmed routine counts the number of blocks recorded on the tape. This total is recorded at the end of the data. When the tape is read into the computer in subsequent runs, a count is made of the number of blocks read. At the end of the tape a comparison is made between the number of blocks read and the number written. If the totals do not match, a re-run is initiated.

Thus, we see that the computer can be used to check on the accuracy with which the manual operations in a data-processing system have been executed.

The method of rerunning a problem is very simple. During the running of a problem the following variables are of significance:

1. The contents of the computer memory

2. The identification of the various tapes on the tape mechanism

3. The block counts of the various tapes in process

In order to rerun, it is necessary to know only those three things. If at the end of each output tape in a run the contents of the memory are written out, a rerun point is established. If necessary, the contents of the registers may also be recorded at this time. Note that the block counts and tape identifications are being stored in the memory for reasons mentioned previously and therefore, all the necessary information for rerun is in the "memory dump". The procedure for rerunning is as follows: When an error is detected, the last output tape produced is mounted on a tape mechanism. A simple routine locates the memory dump at the end of the tape, thereby reconstituting the computer memory. The tape identifications of the various input and output tapes are now available in the memory. They are printed out for the operator and he proceeds to mount the tapes. These tapes are then repositioned making use of the block counts which are stored. This rerun procedure is general and applicable to most data processing runs. For large computers, writing out the computer memory takes less than two seconds and uses less than one percent of the available storage on a reel.

For mathematical problems a similar rerun procedure may be set up. A rerun point is established in the same manner. Rerun points can be established at fixed positions in one program or by operator intervention at frequent time intervals.

- END -

CONFERENCE ON ELECTRONIC DIGITAL COMPUTERS AND INFORMATION PROCESSING, DARMSTADT, GERMANY, OCTOBER 25 TO 27, 1955, -- TITLES AND ABSTRACTS OF PAPERS

A conference on electronic digital computers and information processing took place at Darmstadt, Germany, October 25 to 27, 1955, at the invitation of the Institut für Praktische Mathematik, Technische Hochschule, Darmstadt, as expressed by Dr. A. Walther, conference Chairman.

Following are the titles and English abstracts of the 60 papers, not including those given just after the end of the conference by the two speakers from the U.S.S.R., Lebedev and Basilevsky, whose arrival was delayed. (See "Digital Computers in Eastern Europe" in "Computers and Automation", Dec. 1954, p. 8-9 ...)

At the end of the titles and abstracts is the list of speakers and addresses. It is expected that the papers will be published in proceedings available from the IPM, Darmstadt.

1. A. Adam (Linz/Österreich)
   Statistical operation programs in industry
   The possibility to use computers for the purposes of production research necessarily leads to a corresponding reorganization of management. Therefore the development of standard operation programs to be used again and again in the factory is deemed to be an essential preparatory work. Then it would be evident that the use of a computer is suitable. Two examples are mentioned. Further the author demonstrates in which way production research has to be organized in order to justify the use of computers even for special purposes.

2. H. H. Aiken (Cambridge, Mass./USA)
   The future of automatic computing machinery
   History of the subject -- What has been accomplished -- Where are we going -- How will we accomplish (a) applications to data processing and (b) applications to automatic control -- What will be the effect on society -- What is the responsibility of (a) computer experts, (b) engineers, and (c) educational institutions — Conclusion: We are building a new branch of engineering.

3. K. H. Bachmann (Dresden)
   Specific characters of the Dresden computer D1
   Abstract not available.

4. F. L. Bauer (München)
   Iterative methods of linear algebra with convergence of Bernoulli's and of Graeffe's type
   Iterative processes of linear algebra are to be of Bernoulli's type if their (linear) convergence depends on the final proponderance of one term in a weighted power sum of matrix eigenvalues. Prototypes are the vector iteration for determining the eigenvector belonging to the dominant eigenvalue and more generally a process named staircase "iteration" for simultaneously determining all eigenvectors and eigenvalues of a matrix (the latter case being closely related to Rutishauser's LR-Transformation).

   If an iterative process of Bernoulli's type is accelerated in such a way that the 2^ith iteration quantities are used, one obtains quadratic convergence, which may be called of Graeffe's type.

   A number of important numerical procedures are contained within the staircase iteration and the vector iteration (or in their quadratically convergent abbreviations) as special cases. They are to be studied with respect to their mathematical relationships. Special interest is given to the phenomena of self-correction on the one side, instability and loss of leading figures on the other side, which are significant in numerical computations, especially with automatic machinery.

5. V. Belevitch (Brüssel/Belgien)
   Handling of numbers and orders in the IRSIA--FNRS computer
   The words used for programming are numbers of 18 binary tetrades (15 decimal numbers, 2 decimal numbers for the exponent and one for the sign). The orders have the length of a half-word. The computer is of the single-address type, the result of the last operation remaining in the accumulator. The orders are composed of an address indication (possibly indication of another order in case of jump orders) and an operation symbol. The selection and interpretation of orders on one hand, the selection of numbers on the other hand, and finally the calculation itself are desynchronized; information processing is handled over a cold cathode tube memory which allows a maximum frequency of 25 kc/s for circulation of the tetrades. This corresponds to the relaxation time of 40 μs of the switching matrices of the arithmetic unit using selenium rectifiers.

   The author describes the systematic of pulsing and gating circuits used to combine the orders corresponding to different operations with the characteristic instants at input and output of the matrices. Hereby a fine structure of timing within 40 μs is established.

6. L. Biermann (Göttingen)
   Survey on the computer development at Göttingen, especially the application of the computers G1 and G2
   Abstract not available.

7. H. Billing (Gottingen)
   Switching circuits and memory systems

Main characteristics for the design of switching circuits are according to their importance: Reliability, easy maintenance, speed, costs. From this point of view the most important elements (tubes, diodes, ferrite cores, transistors) are compared. Special requirements for these components in flip-flop and gating circuits are discussed. Because of their reliability ferrite cores and diodes are increasingly used instead of tubes in ring counting circuits, shift registers, parallel registers, and logical elements in the arithmetic unit. A simple logic design of the control unit may be achieved by "microprogramming" techniques. Suitable circuits with ferrite core matrices or ferrit-registers are compared. These switching circuits are assembled to plug-in units if possible.

Ferrite core matrices are increasingly used for rapid access memories. Some selection circuits are compared. Large capacity magnetic tape memories (above 10^8 binary digits) with maximum access time of a few seconds have been used in USA.

8. A. D. Booth (London/England)
Input and output

The various forms of available input-output equipment for automatic computing devices will be reviewed. Their suitability for attachment to computers which employ currently available storage devices will be discussed, and the methods by which accurate dovetailing of the computer and its terminal organs can be achieved will be discussed. Research at present in progress on new forms of input-output equipment will be discussed, with particular reference to magnetic tape and wire and to devices for the direct use of original documents.

9. H. Bottenbruch (Darmstadt)
Subroutines for DERA

The author discusses characteristics of subroutine organization caused by punched card techniques and "Adressenrechenwerk" (special arithmetic unit for address modification). By means of punched card technique it is possible to perform changes of the first kind (substitution of relative addresses) before programme-sequence input. Changes of the second kind may be performed by means of "Adressenrechenwerk". The methods applied in Darmstadt and München are compared. Insertion of short subroutines as open subroutines into the main programme will be discussed.

10. K. Brokate (Sindelfingen)
Address-modification with index registers used in EDPM Type 704

Description of Type 704 -- Index registers in their operation -- Decrement -- Modification of address into effective address -- Index arithmetic -- Index-dependent routines -- Selection of complete subroutines -- Supplements.

11. St. Comét (Stockholm/Schweden)
Operation with BESK

BESK is an electronic parallel computer with cathode ray tubes as rapid access memory. The words are handled to and from the memory in a parallel mode. Words signify numbers in the arithmetic unit and orders in the control unit. A magnetic drum is used as supplementary memory. Input of programme and numerical values by means of punched tape. Output by means of electric typewriters or tape perforators or graphically on a so-called function-recorder. The author describes in his paper the order list.

Since March 1st, 1954, BESK is in regular operation. A survey is given of different problems resolved with BESK and some details are discussed.

Programming of problems is now mostly worked out by the users themselves. Programming courses are arranged by our mathematicians who help the users if necessary. Mainly they are occupied with preparing a library of standard subroutines, which are described.

12. E. W. Dijkstra (Amsterdam/ Niederlande)
Iterative processes for the computation of elementary functions

Iterative processes for the calculation of the square root and the reciprocal are adapted to a fixed point binary machine (range from -1 up to +1), without a built-in division. The adaptation includes a solution of the scaling problem involved, ensuring no loss of accuracy. A fairly good approximation, to be used as starting value, can easily be constructed.

13. H. J. Dreyer (Darmstadt)
The Darmstadt electronic computer DERA

Emphasis of the development: To build a machine of medium speed suitable for long programs as well as for input and output of great amount of information. Convenient handling, release of the arithmetical unit from auxiliary computation of programs. Careful design with simple reliable units.

Representation of numbers and orders on the basis of binary coded, serial decimal figures.

Special features in the main units, arithmetical unit, store, control, input and output.

State of the development.

14. O. Eckert (Lauf)
Critical view of ferrites with rectangular hysteresis loop for application as memory or switching elements in electronic digital computers

Designing physicists and manufacturers of ferrites with rectangular hysteresis loop for application as memory or switching elements have to know some test methods allowing a quick classification of the cores. These methods are discussed shortly: Taking up the hysteresis loop at different frequencies -- The envelope method -- Determination of switching times and of the noise-to-signal ratio. The analysis of the hysteresis loops of these ferrites taken up statically, quasistatically or with high frequency of 100 kc/s can deliver only excluding classifications. It replaces by no means the pulse test. Only this test gives statements on switching time and on the noise to signal ratio. Stemag has developed a method based on Billing's selection test H 1/H 2. Loading the cores with a sequence of pulses con-

tinuously modified in amplitude and inserting a powerful reading pulse, which pulls the core back to -Br, this test makes visible a group of output pulses on the c.r.t. screen. Its envelope allows to define instantly the core's useful range of operation. Then something will be said about opposite tendencies of development in the United States and in Europe.

15. Th. Fromme (Weil)
The representation of the structure and the function of digital information processing machines by the equivalence algebra

For the description of relay circuits Shannon, Plechl, Zuse and others have developed the switching algebra, which is based on the formalism of Boolean algebra. The latter can be modified and extended on many-valued variables, if the negation and the axiom $1 - x = 1$ are replaced by the equivalence operation x^y defined by $x^y = 1$ if $x = y$; $x^y = 0$ if $x \neq y$ for every discrete-valued variable.

The following problems can be treated thoroughly by a kind of tensor formalism.

(1) The representation of states and of sequences of states in a communication system by variables and equations of the equivalence algebra.

(2) The general theory of systems of equations and their solutions.

(3) The extension of the algebra by a precisely defined transportsymbol $a \longrightarrow b$ becomes formally identic with Zuse's "Plankalkül"-algebra of programs.

Special care has been attached to precise definitions of the basic notions of communication theory and of the relations between algebraic symbols and the physical variables of technical communication systems.

An example shows the description of a machine of the "MINIMA" type by the formalism.

16. H. Gillert (Darmstadt)
Something on switching-circuit techniques with ferrite toroids

There will be shown some possibilities to perform logical operations with magnetic cores. By giving examples there will be made statements on projecting, designing and constructing of switching circuits.

17. H. H. Goldstine (Princeton, N.J.)
Systematics of automatic electronic computers

The speaker considers historically the interrelationship between the logical structure and speeds and capacities of electronic digital machines. Using this as a starting point he proceeds to a discussion of the mathematical desiderata of machines viewed in the light of present day mathematical interests. On the basis of these considerations he attempts to establish the speeds and capacities desired for machines in the forseeable future. He then proceeds to see how these speeds and capacities can be achieved and wherein the principal difficulties lie.

18. H. H. Goldstine (Princeton, N.J.)
Numerical procedures for the integration of hyperbolic and elliptic partial difference equations

The author discusses two main topics: the integration by various numerical methods of hyperbolic partial difference equations; and the corresponding situation in the case of elliptic partial difference equations. In the case of hyperbolic ones he states the so-called Courant-Friedrichs-Lewy criterion for stability and discusses generally the relation between stability, convergence and accuracy. He gives a number of explicit integration procedures and an implicit one. In the discussion of the latter method he develops for difference equations a theory of the Green's function and shows its applicability in the present circumstances.

In considering elliptic equations he discusses the work of Frankel and Young principally. His main interest in this calculation is the different notions of over-relaxation and he shows the rate of convergence of these methods.

19. G. B. Greene (Oakland, Calif.)
Data processing
Abstract not available

20. W. Hansen (Hasloh)
Numerical solution of differential equations in hydrodynamics with BESK

Hydrodynamic differential equations of flow in the sea and in rivers. Conversion into nonlinear difference equations and solution by numerical methods. Influence of terms characterizing friction and convection on the stability of the solutions, stability criteria. Application of these methods for numerical solution of practical problems of hydrography and hydraulic engineering with BESK.

21. K. Herold (Nürnberg)
Ferrites and titanates used for decision elements in switching circuits and memory systems

The recent development of materials has led especially in the field of ferromagnetics and ferroelectrics to a great number of new components and thus opened for circuit techniques some interesting possibilities of realization.

Based on the well-known facts for modification of physical qualities of these materials by external fields (control of field density, Faraday-effect, Hall-effect etc.) it shall be examined to which degree components on this base are already used in switching circuits and memory systems of electronic computers. Further it shall be examined which possibilities are given by using new experiences resulting from research on ferrites and titanates especially with view to reduction of tubes and miniaturization.

By means of pictures the author shows constructive details of components and their arrangement in different switching circuits and memory systems.

22. W. Hopmann (Göttingen)
Remarks on the development of G 1a

Based on construction principles of G 1 the Arbeitsgruppe Numerische Rechenmaschinen develops at present G 1a. Input of orders immediately carried out by punched tape sensing devices operating above 100 lines/sec. Magnetic drum memory with 1840 numbers, each number 60 binary digits. Arithmetic unit in binary number system with floating point operation. 13 decimals for mantissa, maximum decimal exponent ±37. Computing

with double accuracy or fixed point operation, also combined, possible by programmed orders. Replacement of address substitution by cyclic interchange over maximum 60 numbers of each track and free assignment of tracks to the 3rd address number. Conditional jump orders dependent on sign of mantissa or exponent or special marking of numbers.

Average operating speed approximately 15--20 operations/sec. 10 punched tape sensing devices for input of orders and numbers. Output on punched tape or with electric typewriter. Keyboard of typewriter may be used for direct input and control. Used components: ca. 250 tubes and more than 1000 diodes.

23. A. S. Householder (Oak Ridge, Tenn.)
Numerical mathematics from the viewpoint of electronic digital computers

A computing system whether or not it includes a human being can be characterized by a list of elementary operations with a reluctance factor associated with each operation. The reluctance factor may be a measure of the time required for the performance of that operation. We can say that numerical mathematics is concerned with the construction of routines with minimal total reluctance for specified systems and which yet satisfy assigned criteria as to precision. When the system includes a human being and only minimal mechanical facilities, a routine can be modified at any stage; when the system in an electronic computer operating at high speeds this is no longer possible or much less so.

Because of this fact, the major change in viewpoint imposed on numerical mathematics by the electronic digital computer lies in this; that precision can no longer be taken casually but must be carefully scrutinized in each routine. Probabilistic estimates are open to question because of the obvious fact that some numbers such as the simple rationals, transcendentals such as e and π, and others will bias distribution in mysterious ways.

Very few systematic techniques are available for analyzing computational errors. Nevertheless a few can be cited having some degree of generality. A certain algorithm for computing latent roots of a symmetric matrix illustrates a principle that seems to be new and that may prove to be useful in other situations.

24. P. E. Klein (Fellbach)
Special requirements for oscillographs to be used for development, testing and monitoring of electronic computers
Abstract not available in English

25. H. Kohler (Sindelfingen)
EDPM 705 in engineering and management

Units composing Type 705. Operation possibilities of each unit. Interactive process of different units.

Daily stock control, also in case of largest and decentralized stocks, by means of 705.

Sorting of data on magnetic tapes. Obtainable sorting speed.

26. T. Lederle (Heidelberg)
Numerical computation of star ephemerides

Spherical coordinates of fixed stars are variable with time on account of: (1) the transformation of the reference system owing to precession and nutation; (2) the aberration of light; (3) the real (proper) motion of the stars. The calculation of the apparent coordinates (as actually observed) may be reduced to a simple formula consisting of the sum of five products. The first factors depend only on the position of the star, while the second factors are common for all stars and depend only on time.

The Astronomisches Rechen-Institut at Heidelberg will compute, as from 1960, the spherical coordinates of all 1483 so called fundamental stars which define the astronomical coordinate system. These ephemerides, given at an interval of 10 sidereal days, are published annually in an international volume "Apparent Places of Fundamental Stars"; each volume contains approximately 60,000 positions or 120,000 coordinate values. Consideration has been given to the most economical method of making these calculations. The use of punched-card machines seems to be advantageous because it is possible to produce copy on an IBM card-controlled typewriter in a form immediately suitable for photolithographic reproduction.

27. N. J. Lehmann (Dresden)
Present status and trends of the Dresden computer development
Abstract not available.

28. N. J. Lehmann (Dresden)
Remarks on automatic computer programming.
Abstract not available.

29. H.-O. Leilich (München)
Physical problems of the construction of recording heads for digital magnetic drum storage

In the development work on the magnetic heads for the drum storage of the PERM, it has been systematically investigated as to what quantities are important in influencing the working of a magnetic head in the digital recording on a drum. As are well known, the two main requirements are high resolution and good energy-efficiency.

For the resolution, the geometrical shape of the pole-shoes and the separation between the magnetic layer and the head are the important influencing factors. The result of theoretical as well as experimental investigations show that the nowadays commonly used construction of the magnetic head out of one or more laminations with small pole-shoes is much more suitable for the drum storage than the type of pole-shoes used in magnetic tape-recorders.

The required magnitude of the recording signal and the voltage-amplitude obtained in the readout are dependent on the shape of the pole-shoes, the layer-head separation and the layer material. By regarding the head as a nonideal energy-converter, an equivalent-circuit diagram is derived which illustrates how the signal energy-transfer is influenced by the resistance of the windings, the magnetic reluctance of the core and the extent of the stray flux.

Technical possibilities for reducing the causes of attenuation are discussed. By adopting these measures in the construction of the magnetic heads for the PERM, a high storage-density and a relatively small amount of required amplification have been achieved.

30. G. Leiser (München)
Magnetic switching circuit technique
Abstract not available.

31. M. Linsman, W. Pouliart (Antwerpen/Belgien)
Main characteristics of IRSIA-FNRS computer
Survey on the logical, mathematical, and technical characteristics of the computer (use of cold cathode glow-discharge tubes for storage, desynchronous operation, unification of calculating units etc.), statement of reasons determining this choice.

32. B. J. Loopstra (Amsterdam/Niederlande)
Processing of formulas by machines
Some of the methods that could be used with present day machines to make them understand the language of mathematics are discussed and disadvantages of these schemes are summarized. The problems connected with the elimination of unintended redundancy from the coding are mentioned.

Some suggestions are given for the incorporation of more of the machine's understanding into its hardware and less into the program with the aim of obtaining better over-all efficiency.

Some preliminary conclusions about the desired logical structure of the machine in this case are presented.

The question of reliability versus amount of equipment is mentioned.

33. W. H. Muller (Amsterdam-Schiphol/Niederlande)
An electronic computer enters an airplane factory
Before the arrival of our magnetic drum calculator, we used matrix methods for our computations on desk calculators whenever possible. After that we continued this practice. We reduced vibration and flutter problems and also the solution of a system of linear simultaneous differential equations with constant coefficients to the determination of eigenvalues and eigenvectors of matrices. Vibration problems give rise to matrices with real elements and real eigenvalues, flutter problems to matrices with complex elements and eigenvalues. For both cases we programmed the iteration method by which the eigenvalue with the largest modulus and its eigenvectors are found. After that, from the matrix D with eigenvalues $\lambda_1, \lambda_2, \cdots, \lambda_n$, written in descending order of magnitude of the moduli, a matrix D_1 is constructed. D and D_1 have the same eigenvectors and both have the eigenvalues $\lambda_2 \cdots \lambda_n$ but D_1 has the eigenvalue zero instead of λ_1, so that λ_2 is the eigenvalue of D_1 with the largest modulus. In this way we are able to find all eigenvalues of D by this reduction process. Extensions of the program are necessary when two eigenvalues are close together, or when as in the third problem a matrix with real elements may have conjugate complex eigenvalues. Then a quadratic equation is constructed from three consecutive iteration steps. The solutions of this equation give new approximations to the two eigenvalues with the largest moduli, e.g. to the two conjugate complex eigenvalues in the last mentioned case. With the aid of these solutions a new approximation to the eigenvector is constructed. When the matrix has real elements, the eigenvector may be real or complex. The program must be able to switch to either case; in the second case, the two conjugate complex roots are annihilated at the same time, so that in the reduction process only real numbers appear. When the matrix has complex elements, this complication does not arise, but the construction and solution of the quadratic equation with complex coefficients have to be done with a floating-decimal-point routine.

34. H. Öhlmann (Göttingen)
Report on completion of G2
The author characterizes the computer G2 and shows its special properties as: number representation, normalization order for facilitation of floating point operation, tape orders for modifications during input, special orders for neat table printing, conditional jumps with multiple dependencies of decision possibilities. Input of numbers and orders in decimal or octal mode. Separate storage of numbers and orders on drum is deemed to be disadvantageous; nevertheless it is maintained.

35. H. Piloty (München)
Survey on the computer development in Munich
Abstract not available.

36. R. Piloty (München)
Observations on the problem of data-processing
The usefulness of today's conventional program-controlled computers for data-processing (DP) appears to be doubtful. For these applications they are clumsy to program and unnecessarily slow, while for scientific computation their value is proven. Therefore, it seems worthwhile to inquire about the essential difference between data-processing and scientific computing.

The main difference seems to reside in that an appreciable proportion of a DP-Problem consists functionally in the task to identify automatically input-data on the basis of coded marks which they bear. A second difference arises from the fact that a DP-System is usually subjected to different and more stringent operational requirements with regard to timing of operations, input and output organization, maneuverability etc. One has to differentiate between real-time and deadline, centralized and decentralized operation. These circumstances lead necessarily in addition to the multi-purpose machine to the special purpose system, which latter is built more or less fixed into an organization.

Future multipurpose machines will have to be better adapted to the fast and easy solution of the identifying problem with regard to their inner structure as well to their programing technique. Since some of the most urgent DP-Problems cannot be solved satisfactorily without a special purpose machine, their development cannot be avoided. Their future significance will depend largely

on the development of suitable building-block systems and short access mass storage equipment.

37. K. Pisula (Göttingen)
Further development of instruction code of G2

After having put into operation G2--based on first experiences in coding, searching and correcting of program errors and in real computing -- it seems to be desirable to modify and ameliorate the instruction code and the arrangement of printed numbers. These modifications have been carried out as far as technical construction allowed. It is shown where these modifications have reduced the "susceptibility to error" of the code and other proposals are made -- not yet realized in case of Göttingen computers -- which eventually might lead to further reduction of this susceptibility to error.

38. W. L. van der Poel (Leidschendam/Niederlande)
The essential types of instructions in an automatic computer

Multiplication, division, extraction, shifting are not necessary in a computer. Addition, subtraction, transfer, jump, conditional jump are sufficient. Of these, addition or subtraction can be eliminated. Conditional jump can be programmed in terms of addition, transfer and jump. A new type of order is discussed, which allows addition and transfer. Finally jump is redundant too.

39. W. E. Proebster (München)
Floating point decimal-binary conversion

In the development work of the PERM, one problem was the conversion of decimal numbers (of the form $n_{dec} \cdot 10^{s}$) into their binary equivalents ($u_{binar} \cdot 2^{t}$) at the input, and conversely at the output.

Starting from given arithmetic rules, reasons for the most important fundamental decisions for the technical realisation are given, and the flow diagrams for the two conversion processes are discussed. The various arrangements provided for the discrimination of the signs of the exponent and the mantissa are described in detail.

Finally, in order to illustrate the switching technique used, the author describes the basic circuit, on which the construction of the resulting control-unit in the PERM was based.

40. C. Ross (Dayton, Ohio/USA)
Interpolation trends for large scale computers
Abstract not available.

41. H. Rutishauser (Zürich/Schweiz)
Report on 5 years of programming work with the Z4 computer

During 5 years of operation in the Institute for Applied Mathematics of ETH the Z4 has rendered good services to the Swiss industry, more by the solution of numerous small problems than by working on monster problems. For this reason the program preparation -- which is relatively extensive especially for smaller problems -- was our main burden. Therefore we tried to simplify programming and handling of the ERMETH to be built whilst less attention was paid to computing speed.

As further means for simplification of program preparation the several well known methods of programming are at our disposal (flowdiagram, subroutine library, conversion routines, etc.) which will be used for ERMETH in a modified manner. The most effective means is, however, automatic programming By this we mean methods for automatic computing of the whole programm according to basic formulas.For this purpose the problems have to be formulated in a special algorithm. For the multiplication of a (n, m) with a (m, p) matrix the spelling is as follows:

For i = 1 (1) n and k = 1 (1) p: $\sum_{j=1}^{m} a_{ij} b_{jk} \rightarrow c_{ik}$

The term to be calculated is always to the right of $\longrightarrow$.

It is said that such a strict formulation — which might also be extended to more complicated systems — would also simplify conventional programming. Therefore it may be proposed generally to use this formulation for all numerical problems.

42. K. Samelson (München)
Problems of programming techniques

The steady progress of programming techniques is increasing the tendency of taking the load of routine programming work off the programmer. The first, still incomplete step in this direction is the preparation of a supply of library routines which sometimes are stored in wired form unless there are directly wired-in routines (Z4, square root). Such a subroutine generally is related to more than one operand address and therefore may be called a multi-address pseudoorder.

Establishing and entering these addresses remains the problem for the programmer.

On the next level, a complete computing program is manufactured by a master program (executive routine, "Superplan") -- prepared especially for this purpose--- from library subroutines and added instructions (regular machine orders as well as other pseudoorders which are not contained in the operation code of the computer). Some of the most important activities of these master routines are basically of so simple a kind that the question may be raised whether a wired-in automatization of these procedures is possible and advisable for reasons of simplicity and security.

43. H. Schecher, F. L. Bauer (München)
Basic ideas for the logical design of a computer with independent address operation unit.

In the present state of programming techniques explicit address operations are of an importance equal to that of arithmetical operations. In the sequence control of conventional computers, however, address operations -- even if automatized to some extent -- are still treated as subordinate. This disadvantage can be eliminated by using a separate address operation unit, (including storage facilities); the rigidity of its mode of operations is removed by providing for a special sequence control. A characteristic is the inclusion of the control counter into the address operation unit.

(cont'd on page 32)

COMPUTER PEOPLE: MASTER FILE ON PUNCH CARDS

EDMUND C. BERKELEY

For more than a year "Computers and Automation" has been maintaining a master file on punch cards containing the names and addresses of all computer people we know. It may interest our readers to know the procedure we have used. Here are the details.

The file was originally assembled in February, 1955, from all the lists that we could then find. As of March 1, this file has been used three times: for our Who's Who mailing a year ago; for the mailing in August, 1955 announcing the Eastern Joint Computer Conference meeting November, 1955 in Boston; and for the mailing in December, 1955, announcing the Western Joint Computer Conference in San Francisco, February, 1956. During March we expect to use it for our second annual Who's Who mailing. Anyone who is interested in computers we believe should have his name and current address in this file. Anyone who sends us his Who's Who entry we put into this file.

This file has not been used and will not be used by us or by anyone for advertising purposes, but only for computer people meetings, and for our annual Who's Who mailing. The file would be available for example to the Association for Computing Machinery for announcing their fall meeting, if they should request it.

Contents of Cards

Each punch card contains:

(1) Code identifying the source (4 columns);

(2) Two initials of the person (2 columns);

(3) Last name of the person (14 columns);

(4) Company or organization (14 columns);

(5) Street address (18 columns);

(6) City and state (17 columns);

(7) A blank field of 10 columns, free for other uses.

The actual location of the information is shown in Table 1.

In regard to abbreviations, key punch operators are instructed that any abbreviation that the post office can understand is acceptable when abbreviating names and places. For example, LOS ANGELES 45 CAL occupies 18 columns; but writing it as LOS ANGELES45CAL, which omits two spaces, abbreviates this phrase into 16 columns and so it fits into the 17 columns of Field 6. (In other words, there are 57 ways of being right in this style of abbreviating.)

The codes identifying sources that have been used so far in Field 1 are shown in Table 2.

Procedure

The procedure that has generally been used in regard to operations with these punch cards is this:

1. Any mailing sent out is marked "Form 3547 requested"; then the undelivered envelopes come back and show new addresses. New names and addresses are punched and interpreted. This is the correction file.

2. Any new list (of meeting registrants, etc.) is punched and interpreted. This is the additions file.

3. The previous file, the corrections file, and the additions file are sorted on the 5 leading letters of the last name and the first initial, and thus all cards for the same person are brought very close together.

4. The whole file is then edited by a competent clerk. She notices all cards that are apparently for the same person. She chooses the most recent card with a reasonable address since that is the card most likely to give the best address. She removes the other cards; after several weeks, they are thrown away. She also returns cards with inadequate addresses to the key punch operator to repunch, referring again to the source.

5. The cards are then run through a Type 407 tabulator to make either slips for insertion in window envelopes or labels for affixing.

General Use

The editors of "Computers and Automation" propose that this style of punch card be used in general for names and addresses of computer people so that different contributions into the file and out of the file can be made with ease, to the advantage of all concerned.

We shall make sure that this Master File is never abused, by seeing to it that it is not used for advertising purposes outside of the "Who's Who". In fact, we maintain a separate file on metal address plates, which we call our J3 file, where we put publicly available names of computer people, for mailing list purposes. Here for example we put expiries to "Computers and Automation".

Table 1

LAYOUT OF CARD

I. PUNCHES -- 80 COLUMN

Field	Columns	Meaning	No. of Columns
1	1-4	Code identifying sources and classes, as follows:	4
		-- Column 1: last digit of calendar year of source;	
		-- Columns 2-3: serial no. of source within year;	
		-- Column 4; punch 1 for class computer people, punch 2 for class management people.	
2	5-6	Initials of Person	2
3	7-20	Last Name of Person	14
4	21-35	Company or Organization	15
5	36-53	Street Address	18
6	54-70	City and State	17
7	71-80	Blank: not used in master file	10

II. INTERPRETATION -- 60 COLUMN

Field	Columns	Meaning	No. of Columns
Top Line			
1	1-14	Last Name	14
2	16-18	Initials (one space)	3
3	55-60	Code identifying source (two spaces)	6
Second Line			
1	1-15	Company or organization	15
2	17-34	Street Address	18
3	36-52	City and State	17

Table 2

CODES IDENTIFYING SOURCES

Column 1: Last Digit of Year of Source	Columns 2-3: Serial No. of Source Within Year	Column 4: Class of Person	Source
3	01	1	Consolidated List of Attendance, Eastern Joint Computer Conference 1952 and 1953
3	02	1	Western Joint Computer Conference, Attendance, Feb. 1953
4	01	1	Assoc. for Computing Machinery, Membership, June 1954
4	02	1	Preregistration, Ann Arbor, June 1954
4	03	1	Wayne Univ. Computation Laboratory, Meeting, Registration, June 1954
4	04	2	Inst. of Management Sciences, Membership, April 1954
4	05	1	Western Joint Computer Conference, Attendance Feb. 1954
4	06	1	Computers and Automation Expiries (persons only), about Dec. 1954
4	07	1	Computers and Automation Subscribers (persons only), about Dec. 1954
5	01	1	Joint Computer Conference, Attendance, Dec. 8-10, 1954
5	02	1	Western Joint Computer Conference, Attendance Feb. 1955
5	03	2	Inst. of Management Sciences, Membership, 1955
5	05	1	Corrections of Who's Who Mailing, Summer, 1955
5	06	1	Eastern Joint Computer Conference, Boston, Registration, Nov. 1955
6	01	1	Western Joint Computer Conference, San Francisco, Registration, Feb. 1956 (not yet received)
6	02	1	Corrections of WJCC Mailing, March 1956

\- END -

PRODUCTS AND SERVICES FOR SALE:

THE COMPUTER FIELD – HEADINGS

Following is the preliminary list of headings which we expect to use for products and services in the listing of them in "The Computer Directory, 1956", the June 1956 issue of "Computers and Automation".

If you notice headings that you wish to be very sure that your products or services are included under, please send us entries at once (see details on p. 24. Although the closing date for this section was the end of March, we expect to be able to squeeze in additional entries up to April 30 or the first few days in May.

GUIDE TO THE HEADINGS

A: Adding Machines
Addressing Machines
Analog Computers
Analog-to-Digital Converters
Arithmetical Circuits (for Digital Computers)
Automatic Control Equipment

C: Capacitors (computer types)
Card-to-Tape Converters
Computer Components (see also specific types)
Computer Test Equipment
Computers (see also: Analog Computers, Digital Computers) -- this heading "Computers" should be avoided if possible
Computing Services
Connectors (computer types)
Consulting Services
Courses by Mail (computer field)

D: Data Processing Machinery (see also Digital Computers)
Data Retrieval
Delay Lines (computer types)
Desk Calculators
Differential Analyzers (see also Analog Computers)
Digital Computers
Digital-to-Analog Converters
Diodes (computer types)

E: Electric Typewriters, controlled
Electronic Tubes (computer types)

F: Fire Control Equipment

K: Keyboards

L: Line-a-Time Printers
Logical Circuits (for Digital Computers)

M: Magazines
Magnetic Cores (computer types)
Magnetic Drums
Magnetic Heads
Magnetic Storage Systems
Magnetic Tape
Magnetic Tape Handlers (see also Magnetic Tape Recorders)
Magnetic Tape Recorders (see also Magnetic Tape Handlers)

P: Paper Tape Filing Systems
Paper Tape Punches
Paper Tape Readers
Patchcords
Photoelectric Card Readers
Photoelectric Decoding Readers
Photoelectric Tape Readers
Photographic Recorders (computer types)
Plotters
Potentiometers
Printers (see also Line-a-Time Printers, Electric Typewriters, controlled)
Publications (see also magazines)
Pulse Transformers
Punch Card Machines

R: Recording Papers
Rectifiers
Relays (computer types)
Resistors
Resolvers
Robots, Small

S: Scanners
Signaling Controls
Simulators
Stepping Switches
Synchros

T: Tape-to-Card Converters
Transistors
Translating Equipment

V: Visual Displays

If your products or services do not fit under any of the above headings, we will gladly consider your suggestions for other headings.

- END -

PRODUCTS AND SERVICES FOR SALE:

THE COMPUTER FIELD – ENTRIES

In February we mailed out to about 500 organizations an invitation for entries in Part 2 of The Computer Directory, 1956: "The Computer Field: Products and Services for Sale". As we prepare the April issue, a great many entries are flowing in. Although the closing date for this section was the end of March, we expect to be able to squeeze in additional entries up to April 30 or the first few days in May.

In "The Computer Directory, 1955", we published more than 600 entries, and we expect that the number in 1956 will be larger. The preliminary list of the headings that we expect to use in June, 1956 appears on p. 23.

For each entry of a product or service, we want the following information:

(1) Name or identification of product (or service):____________________

(2) Brief description (20 to 50 words): _____

____

____

(3) How is it used?__________________

(4) What is the price range?____________

(5) Under what headings should it be listed?

____

Organization______________________

Address__________________________

Filled in by______________________

Title_________________ Date__________

Accompanying each entry we request a nominal charge of $6, to help defray the cost of preparing and printing.

A sample entry taken from the 1955 directory from under the heading "Punch Card Machines" is as follows:

> Remington Rand Inc., 315 4th Ave., New York 10, N. Y. / Calculating Punch: 90-Column Tabulating Card Calculating Punch, Type 330-2 / DESCR: adds, subtracts, multiplies, and divides values punched into cards; punches results into some card or any or all following cards; various computations can be performed simultaneously / USE: in accounting machine procedures / $235 monthly rental, $16,675 sale; prices subject to tax

The product description above contains 26 words; there may be up to 50 words -- but the description (and the whole entry) is subject to editing.

- END -

Forum

ASSOCIATION FOR COMPUTING MACHINERY MEETING, AUGUST, 1956, LOS ANGELES

The Association for Computing Machinery has accepted an invitation from the University of California at Los Angeles to hold its Eleventh Annual Meeting on the Westwood campus August 27-29, 1956. Local arrangements will be under the direction of Dr. Gilbert King, International Telemeter Corporation. Correspondence concerning arrangements should be addressed to the Association for Computing Machinery, Box 3251, Olympic Station, Beverly Hills, Calif.

Contributed papers concerned with all phases of analog and digital computation are solicited. The amount of time to be allotted to each contributed paper will be limited to 15 minutes. Each person wishing to have a paper considered for the contributed program must submit to the Program Committee by May 15, 1956, 3 typewritten copies of a 100-word abstract and 3 typewritten copies of the complete manuscript. The original copy of the manuscript should be on unfolded 8-1/2 by 11 inch white paper so that it will be suitable as copy for photo-reproductions to be provided registrants at the meeting. The manuscript, including any drawings, must not exceed four pages.

Send abstracts and manuscripts to J. P. Nash, Chairman, ACM Program Committee, University of Illinois, Urbana, Illinois.

Papers for the program will be selected by the Program Committee after May 15. It will not be possible to consider papers which are not submitted in triplicate or which arrive after the deadline.

- END -

FORUM

WAYNE UNIVERSITY, DETROIT, SUMMER PROGRAM ON COMPUTERS, JULY 23 TO AUG. 11, 1956

Arvid Jacobson
Director, Computation Laboratory
Wayne University
Detroit 1, Mich.

Following is a preliminary announcement of our summer program dealing with electronic computers and their business and industrial applications. This will be the fourth summer in which these intensive and comprehensive training courses will be offered. Last summer, for instance, nearly 400 students from various parts of the country attended the summer program at Wayne University. Nationally-known specialists participated as lecturers and discussion leaders.

We would greatly appreciate it if you would make mention of our program in COMPUTERS AND AUTOMATION. As you know, the shortage of trained personnel in the computing machine field is extremely acute. It is important that we train people for this new field which is so intimately related to our industrial progress and national security.

WAYNE UNIVERSITY COMPUTATION LABORATORY Summer Program Preliminary Announcement

The Computation Laboratory of Wayne University is again offering an intensive summer training program of three weekly courses. Every effort will be made to have as broad a coverage of the important areas in computer developments as were achieved in our three previous summer programs. Likewise, competent and well-qualified experts from various parts of the country will constitute the staff as before.

First Course: July 23 - 28

Automatic Computers -- Their Application and Evaluation

Thorough coverage of computer principles and organization, fundamentals of programming and coding. Illustrative examples drawn from engineering and business. Survey and evaluation of available equipment. Lectures, discussions and tutorial sessions. Laboratory periods in the solution of problems on Burroughs UDEC, IBM 650, and other equipment. Visits to other local industrial and business computation centers.

Second Course: July 30 - August 4

Electronic Data Processing in Business and Government

Recent developments in the application of electronics to business. Preparation for the introduction of electronic data processing. Case histories and critical evaluation of major projects underway. Emphasis on approach with respect to equipment and different business systems. Programming and flow charting of business applications. Consideration of data processing from the standpoint of optimization in terms of mathematical programming. Lectures, conferences, and laboratory sessions. Computation Laboratory equipment available for processing programs prepared by students. Also major data processing systems in the area will be available for demonstration and running of sample programs.

In this course it will be assumed that the students have taken the first course or have equivalent training or experience.

Third Course: August 6 - 11

Applications of Computers to Engineering, Science and Industry

Study of applications with special attention to numerical methods and advanced programming techniques. Illustrative problems will be taken from engineering, physical, social, and management sciences. New areas of application will be explored and new mathematical and programming methods will be presented. Scheduled lectures in the major areas will be held. Discussions and conferences will be arranged for exchange of experience and new techniques. The Burroughs UDEC and the IBM 650 will be available for student use during Laboratory sessions. Large-scale electronic computers will also be available in the area for demonstration and solution of sample problems.

* * * * *

The final program with full information on lectures, staff, and other pertinent information will be distributed well in advance of the summer courses. For further information, write to A. W. Jacobson, Director, Computation Laboratory, Detroit 1, Michigan.

- END -

PUBLICATIONS FOR BUSINESS ON AUTOMATIC COMPUTERS: REFERENCE LISTING

Part 2

NED CHAPIN
Illinois Inst. of Technology
Chicago, Ill.

This paper supplies a reference listing of publications for business on automatic computers. This reference listing is in addition to the "Basic Listing" and the "Supplemental Listing" that were published in "Computers and Automation" for September, 1955, and February, 1956, respectively.

Two types of publications are cited in this reference listing. The first type is on various aspects of automatic computing equipment and devices, and the publications are listed under the following headings: Particular Automatic Computers, Automatic Computer Listing, Special-Purpose Equipment, Particular Devices, Paper Tape, and Punched Cards. The second type of publication cited in this reference listing is on the general application and use of automatic computers in business. This general listing is not further subdivided because the publications cited usually contain repetitions and further elaborations of the material covered by the publications in the "Basic Listing" and in the "Supplemental Listing".

To facilitate reference, the order of listing within each major grouping of the publications cited in this reference listing is alphabetic by author. To conserve space, annotation has been omitted, and items from news magazines have been omitted.

* ——————— *

Part 2 of this listing appeared in the March, 1956 issue of COMPUTERS AND AUTOMATION

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Grandjean G. Jewett, "A Survey of Available Electronic Computers," Journal of Accountancy, Vol. 96, No. 2 (Aug. 1953), pp. 182-189

Paul Kircher, Electronic Computers and Accounting: Industrial Logistics Research Report Discussion Paper No. 33 (Los Angeles: UCLA, 1953) 41 pp.

John A. Kley, "Are You Getting Ready for Electronics," Banking, Vol. 46, No. 5 (May 1954), pp. 38-39

Benedict Kruse, "Electronic Brain Keeps Tab on 11500 Rexall Stores," American Business, Vol. 24, No. 12 (Dec. 1954), pp. 12, 41-44

John Kord Lagemann, "If Robots Run the Works," Nation's Business, Vol. 39, No. 3 (March 1951), pp. 31-33, 80-81

C. C. Laubacher, "A Restricted Survey," Electronic Data Processing in Industry (New York: American Management Association, Inc., 1955), pp. 65-69

John Lear, "Can a Mechanical Brain Replace You?" Colliers, Vol. 131, (April 4, 1953), pp. 58-63. Also, in condensed form: Science Digest, Vol. 34, No. 2 (Aug. 1953), pp. 42-47

T. V. Learson, "Electronic Accounting Machine Developments: IBM", Workshop for Management (New York: Management Magazines, Inc., 1955), pp. 294-300

T. V. Learson, "The Machine Accountant's Role in Electronic Data Processing," Punched Card Annual, Vol. 3 (Detroit: Punched Card Publishing Co., 1954), pp. 7-9

Robin Leatherman, "Getting Facts Faster," Systems, Vol. 17, No. 4 (April 1953), pp. 7-8

Lawrence P. Lessing, "The Electronic Era," Fortune, Vol. 44, No. 7 (July 1951), pp. 136

Everett J. Liversey, "Electronics in Savings Operations," Banking, Vol. 47, No. 10 (April 1955) pp. 41, 134

Everett J. Liversey, "The Electron in the Bank," Banking, Vol. 46, No. 9 (March 1954), pp. 74, 76, 78

Warren P. Livingston, "Automatic Accounting Machines," Internal Auditor, Vol. 10, No. 4 (Dec. 1953), pp. 31-39

A. T. Maierson, et al., A Machine System for Accepting, Storing, and Searching Engineering Data on Electronic Components (Columbus, O: Battelle Memorial Institute, June, 1952), 21 pp.

William L. Martin, "A Merchandise Control System," Trends in Computers (New York: Institute for Radio Engineers, Inc., 1954), pp. 184-191

G. M. McDowell, "Applying Electronic Machines to an Inventory Problem," Workshop for Management (New York: Management Magazines, Inc., 1955), pp. 364-368

W. W. McDowell, "Will Electronic Principles Make Possible a Business Revolution?" Trends in Computers (New York: Institute for Radio Engineers, Inc., 1954), pp. 9-12

Russell B. McNeill, "A Look at Future Developments," Electronic Data Processing In Industry (New York: American Management Association, Inc., 1955), pp. 237-240

J. W. Milliken, "Computers to Control Operations," Railway Age, Vol. 138, No. 2 (Jan. 10, 1955), pp. 138-139

Don G. Mitchell, "Information, What We Want, When We Want It," Systems, Vol. 19, No. 4 (July-August 1955), pp. 8-9

Don G. Mitchell, "Introduction," Electronic Data Processing in Industry (New York: American Management Association, Inc., 1955), pp. 9-14.

Don G. Mitchell, "Why We Are Building an Electronic Data Processing Center," American Business Vol. 25, No. 6 (June 1955), pp. 34, 36

Wm. J. Morlock, "Greatest Electronic Expansion to be in Office Mechanization," The Office, Vol. 41, No. 3 (March 1955), pp. 7-10, 12, 15-16

Office Methods Division of Navy Department, "What About Electronic Computors," Office Executive, Vol. 28, No. 2 (Feb. 1953), pp. 22-23

Ascher Opler, "Save Time, Money, with Computer," Chemical Engineering, Vol. 16, No. 10 (Oct. 1954), pp. 197-208

Carl O. Orkild, "Approaching Automation in a Casualty Insurance Co.," Computers and Automation, Vol. 4, No. 2 (Feb. 1955), pp. 19-22

Roddy F. Osborn, "A First in Industry," Systems, Vol. 18, No. 1 (Jan. 1954), pp. 9-11

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Roddy F. Osborn, "General Electric Installs Electronic Computer for Accounting Operations," Management Methods, Vol. 5, No. 3 (Feb. 1954), pp. 52-53

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A. E. Puutio, "Automation is in the Cards, Prepare for It," NACA Bulletin, Vol. 35, Section I, No. 10 (June 1954), pp. 1245-1251

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Arvid E. Roach, "Life Was Too Short," Steel, Vol. 131, No. 21 (Nov., 29, 1952), pp. 129

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A. B. Sands, "Electronics Charts Sales Picture," Systems, vol. 18, no. 8 (Nov. - Dec. 1954), pp 6-7

David Sarnoff, "Electronics in the Office," Office Management and Equipment, vol. 13, no. 8 (Aug. 1952), pp 20-22, 70-77

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A. J. Schnese, "Electronic Processors in the Insurance Industry," The Office, vol. 41, no. 1 (Jan. 1955), pp. 112, 196-197

Hans Schroeder, "Computers to Make Administrative Decision?" Computers and Automation, vol. 4, no. 3 (March 1955), pp. 28, 29.

Julius Shiskin, "An Application of Electronic Computers to Economic Time-Series Analysis," Analysts Journal, vol. 11, no. 2 (May 1955), pp. 35-37

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Ralph G. Sinn, "Simplify Your Routines to Prepare for Electronics," The Office, vol. 41, no. 1 (Jan. 1955), pp 114

Robert M. Smith, "Automation in the Office," Office Management, vol. 16, no. 3 (March 1955), pp. 28-29

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Gordon Spencer, "Statistics and Automatic Computers," Computers and Automation, vol. 4, no. 1 (Jan. 1955), pp. 6-7, 13

Aorde Steel, "Automation--How Soon and How Much," Auditgram, vol. 31, no. 3 (March 1954), pp 42-47

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Milton Stone, "Data Processing Begins at Home," Automation, vol. 2, no. 8 (Aug. 1955), p. 48

Leonard W. Swanson, Tools of Operations Research, Operations Research Seminar (Chicago: Society for the Advancement of Management, 1954), 8 pp

B. W. Thomas, "High Speed Computers," ISA Journal, vol. 2, no. 3 (March 1955), pp 73-76

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John S. White, "How We Planned for Use of Electronic Equipment," NACA Bulletin, vol. 36, no. 10 (June 1955), pp 1343-1347

K. B. Willett, "Electronics Will Increase Demand for Office Workers," The Office, vol. 37, no. 1 (Jan. 1953), pp 96

R. T. Wiseman, "Combined Operations in a Life Insurance Co.," Computers and Automation, vol. 2, no. 9 (Dec. 1953), pp 11-13

- END -

Forum

REMOVABLE AND INTERCHANGEABLE TYPEWRITER TYPE

A. C. Hancock
Remington Rand, New York, N. Y.

Removable and interchangeable typewriter type -- a new development permitting the typist herself to change one or all of the characters on her machine in a matter of minutes -- appears on the new 1956 model Remington Standard Typewriter.

The typewriter, in addition, has an expanded keyboard with 44 characters, which enables the user to take greater advantage of the new interchangeable type; in its standard arrangement it provides the four extra characters: section mark, paragraph mark, plus sign, and equal sign.

All current and old model Remington Standards and Electrics can easily be re-equipped with special type-bars to receive the new interchangeable type faces. The new interchangeable type allows one machine to do the work of several, and makes ordinary office typewriters much more versatile.

In making type changes, the typist does not have to touch the type with her fingers, nor remove typing from the machine. Using a simple pair of tweezers, she removes the old type block, selects a new one, and snaps it into place. place. The clue to the device is a tiny spring retainer clip on each type block which snaps onto the type-bar; once in place, the character is as firmly fixed and perfectly aligned as ordinary type.

Government, business, or professional offices whose work requires the use of special type-characters -- mathematical, medical, engineering or musical symbols, for instance -- can now keep a supply of these characters on hand and snap them into their machines as needed, instead of investing in special machines or entering them by hand into typewritten text. Foreign language characters, symbols, and punctuation marks will also be available to meet typing needs of foreign legations and organizations, import-export concerns, and college foreign language departments.

Note by the Editor: Wherever an electric typewriter is used as an output by an automatic computer, this development has an immediate and important application.

THE COMPUTER DIRECTORY, 1956:

NOTICE

The June 1956 issue of "Computers and Automation" will be the second issue of "The Computer Directory". Last year we published the first issue, 164 pages. Our present plans for the June 1956 directory follow:

Part 1 of the directory in 1956 will be a cumulative "Roster of Organizations in the Computer Field" based on the last cumulative roster (published December 1955, containing about 330 entries) and brought up to date. Entries in this roster will be free. If you know of any changes, additions, or corrections which should be made in the entries, please tell us.

Part 2 of the directory will be the second edition of "The Computing Machinery Field: Products and Services for Sale." Over 600 entries on 21 pages appeared in the first edition in June 1955; a considerable increase is anticipated. The previous entries, and blank forms, were sent in February, to suppliers for review, checking, and additions. A nominal charge of $6.00 an entry is requested from each supplier in order to help defray the cost of preparing and printing the directory; but if the charge is not paid, the entry may still appear in condensed form, if desirable to make the listing complete.

Part 3 of the directory will be the third edition of the Who's Who in the Computer Field. In the June 1955 issue, about 7500 entries appeared on 96 pages; of these about 2600 were full entries, and the remainder were brief entries. Our present plans are to publish only new or revised Who's Who information in the June 1956 directory. Blank forms for new or revised entries were sent in March to all computer people we know of. A nominal charge of $2.00 an entry or other support of the Who's Who was requested from each person whose entry is printed, in order to help defray the cost of preparing and printing the Who's Who.

The main reason for the nominal charges mentioned above is that we look on the directory as a service to many people in the computer field; yet so far it has not paid for itself; and we need to make a compromise, publishing at least some information about everything that should appear in the directory, but fuller information for those who have shared directly in the cost.

(cont'd from page 19)

By means of a block diagramm certain obvious possibilities and advantages of use are discussed (e.g. free use of several index registers, very simple execution of Anderungen II. Art with consequences to the assembling of subroutines, programming (to a large extent) free of addresses without use of compiling routines).

44. A. Schlüter (Göttingen)
Considerations on a high speed parallel computer

Using of ferrite toroids in high speed computers allows the construction of a large scale rapid access memory and the installation of machine orders consisting of a great number of elementary machine operations. It is examined to which degree these possibilities may be used to facilitate combination of complicated routines. The author discusses the introduction of a great number of index- or step-registers -- 64 are provided -- and of special orders for automatic connection of library subroutines and for simplification of counting.

45. C. S. Scholten (Amsterdam/Niederlande)
Transfer facilities between memories of different types

The problem dealt with here arises from the use of really large scale memories. Selecting information directly out of these memories requires a lot of apparatus and a waste of memory space on account of the long addresses that must be used. Suggestions are made how to avoid these difficulties and, amongst other methods, the use of buffers is found to be very convenient.

Other advantages of buffers are discussed, and finally a few words are said about what has been done in the ARMAC (Automatische Rekenmaschine Mathematisch Centrum) will regard to the communication between its drum memory and its magnetic core memory, part of which serves as a buffer for orders.

46. W. Schütte (Darmstadt)
Technical specialties of DERA

1. Stabilization of flipflops and invertors

Stabilization is achieved by clamping diodes. By this, signals are to a high degree independent from operation voltages and values of components. Attenuated signals are reamplified to rated (nominal) amplitude.

2. Pulse timing unit

Timing pulse gear wheel fixed to the rotor of the magnetic drum serves for control of electronic devices producing timing pulses. This unit consists of an aluminium disk, the nickel plated circumference of which has milled slots forming a 5-track high-precision circular scale. Recording by special magnetic heads. Advantages: high robustness — timing tracks cannot be washed out —also in case of great distance head-layer high peak voltages and optimal pulsing forms.

3. Selection of reading heads

Reading heads are selected by electronic selection switching devices consisting mainly of Germanium diodes. By this circuit high band width and cross talk transmission equivalent can be obtained.

4. Data transfer between punched card input-output unit and computer

Because of different modes of number representation in the punched card unit (parallel) and in the computer (serial) a code modification must be carried out when transferring data. Locations of cells of the same value are recorded together (in groups), the value itself is once recorded separately to or from the magnetic drum. Syncronous operation between punched card unit and magnetic drum is not necessary.

47. A Speiser (Zürich/Schweiz)
Control panel and input and output facilities of ERMETH

Input and output of information for ERMETH are carried out with punched card apparatus of the Remington Rand type. Mechanical crossbar selectors serve for buffer storage and for selection purposes. Results are recorded with a typewriter, the printing arrangement of which may be selected on a plugboard; in addition there is a tabulator of our own development which prints two 16-digit numbers per second. For manual input of orders and numbers, several keyboards with mechanical interlocking are provided. Visual indication of numbers is performed with digit-carrying wheels driven by an electric motor; these wheels display a 16-digit number within 1/2 second. The described apparatus are illustrated by slides.

48. F. Stolze (Sindelfingen)
Experiences with tubes and other components used in electronic digital computers manufactured in Germany

Technical literature of the U.S.A. presents many reports on usability and reliability of electronic components for computers. Up to now in Germany it had not been possible to make similar experiences on a large number of components. Since spring 1954 the IBM at Sindelfingen near Stuttgart is manufacturing the Electronic Calculating Punch Type 604 equipped with German components.

Besides a short technical explanation of IBM Type 604 the author gives a description of used methods for testing, control and statistical evaluation of all components. This control has now been extended to some 10,000 tubes and some 100,000 resistors and capacitors. It is shown to which degree the different components contribute to the total number of errors. Further the kinds of errors in different components are expressed as percentage.

Most of the tested components which were defective have been eliminated at preventive maintenance in order to avoid a failure of the machine during computing. The method of preventive maintenance is described because an especially high reliability of computers is reached.

The results obtained in Germany are compared with those obtained in U.S.A.

49. R. Thun (Hof)
Physical programming

Tables are described which make possible the determination of 3-address-instructions by means of physico-technical considerations without difficult mathematical transformations. This method of programming may be useful for digital and analog computers.

50. B. Thüring (Karlsruhe)

The automatic programming of UNIVAC by the A-2 compiler system

The A-2-compiler system provides a means of automatic conversion of a defined instruction code into another defined instruction code, the latter of which is the own code of the UNIVAC, the so-called C-10-code. The programs directing the computing operations are encoded by the C-10-code which is a 1-address code determinating the sequence of the elementary operation steps. However, as the problems to be computed are originally given in a specific mathematical form requiring eventually complex instructions (as for instance for calculating a logarithm, a sinus, a polynomial sum or for transferring a certain quantity of numbers etc.), these complex instructions initially have to be encoded by a so-called pseudo-code. In many cases these instructions will be 3-address-instructions, the addresses of which may often be variable.

The conversion of the pseudo-code into the C-10-code is accomplished automatically in the UNIVAC by a compiling method. Using this method several C-10 subroutines have to be stored on a magnetic tape (library tape). Another tape (pseudo-code-tape) contains the problem converted by the pseudo-code. On the compiler instruction tape the proper compiler program is written, by which the required subroutines are selected by means of the pseudo-code instructions. The compilation of these tapes will give the final C-10 instruction tape.

The contents of this tape is transferred into the working storage and will be used for performing the computations.

The essential peculiarities of the C-10 code and the pseudo-code will be explained by samples.

51. W. Uhl (Wetzlar)

Expanded switching technique at Z 5 according to experiences

The author reports on some special modifications of switching technique applied to (or being prepared for) Z 5 for (1) further simplification of programming, (2) facilitation of checking in case of occurrence of an error, (3) reduction of time necessary to solve a problem.

(1) Jump order (conditional or not conditional which causes automatic punching of certain words to be scanned (automatic programming in case of similar problems).

(2) Constants storage (constants of form $2^a \cdot b$) manually adjustable enables easy checking of the arithmetic unit. Recording of contents of punched tape by automatic typewriting.

(3) Operations to be worked out: sign $y \cdot \sqrt{x}$ Maximum integral multiple of x.

52. H. Unger (Darmstadt; Hannover)

Works carried out by the Darmstadt mathematical computer group

(1) Works on programming: Composition, expansion and examination of the instruction list -- Punched cards for input and output -- Scrutinizing time waste with and without Adressenrechenwerk -- Invention of "Fünfersprung" (jumping in spaces of 5 words) -- Effectiveness and size of a rapid access memory for storing instructions and numbers -- Special conversion routines and subroutines, computing with double accuracy, computing with complex numbers, computing of elementary functions -- Program input and insertion of subroutines -- Suitable methods and time necessary for making programs.

(2) Problems carried out, numerical methods: Works on the Darmstadt Bull punched card unit -- Works on other punched card machines with electronic arithmetic unit and on the Swedish computer BESK. Statements on different methods of practical analysis.

53. S. Vajda (Teddington/ England)

Experiences in Linear Programming on Computers

Remarkable progress has already been made in the technique of processing and exhibiting data by means of electronic equipment. However it is equally important to develop methods of computation enabling us to draw conclusions.

Linear Programming is one of these methods. It deals with the maximization of a linear form having variables subject to linear inequalities. The solution of such a problem may also require the use of electronic equipment.

The talk contains an account of some experience in Linear Programming on computers. Various methods will be mentioned and a new method will be described which may have some advantages over the methods used hitherto.

54. R. De Vogelaere (Notre Dame, Indiana/USA)

On a new method to solve in the large some nonlinear differential equations using highspeed digital computers

The method depends on work of Poincare and Birkhoff. It is based on properties of transformations T such that there exists an involution R with $(TR)^2 = 1$.

It can be applied, among others, to differential equations of type

$$\ddot{x} = f(x,t) \text{ with } f(x,t) = f(x,t+\tau)$$

and with a symmetry condition, such as f(x,t) f(x,—t)

$$\text{or of type } \ddot{x} = \frac{\partial}{\partial x}U(x,y);\ \ddot{y} = \frac{\partial}{\partial y}U(x,y) \text{ with}$$

$U(x,y) = U(x, -y)$.

The transformation T is deducted from the differential equation, the relations $R^2 = 1$, $(TR)^2 = 1$ depend on the symmetry condition.

The method permits to obtain most of the periodic solutions stable and unstable, by integrating with initial conditions depending on one parameter. The integration can be performed with any step by step method, for instance the author's

one (J. of Research, Nat. Bureau of Standards, March 1955).

It has been used for the Störmer's problem as well as for Duffing's equation $\ddot{x} + x + x^3 = F \cos \omega t$.

55. K. Wenke (Ludwigshafen)
Experiences and problems for inversion of matrices by punched card methods

Statements on used computers — operation processing using elimination method — time to be spent, experiences and problems on propagation of round-off errors. Matrices up to order 22 have been practically treated till now.

56. A. van Wijngaarden (Amsterdam/Niederlande)
Scientific computing in the Netherlands

The author surveys some special problems solved by automatic computing during the last years.

57. M. V. Wilkes (Cambridge/England)
The attainment of an optimum interval of integration in numerical quadrature and solution of differential equations

The procedure performing a numerical integration falls into two parts: (1) the division of the total interval of integration into a number of sub-intervals, and (2) the application of a suitable integration formula to each sub-interval in turn. If the sub-intervals chosen are too large in relation to the formula used and to the accuracy required, truncation errors will be introduced; if they are too small, excessive time will be consumed in performing the integration. The paper is concerned with the problem of devising methods, suitable for use with a digital computer, which enable an approximately optimum division into sub-intervals to be made automatically.

58. F. Wippermann (Frankfurt)
Use of computers for numerical weather prediction

A survey is given on the development of methods of numerical weather prediction during the post-war years. Mathematical problems and methods for their solution are discussed. Requirements for computers regarding computing speed and capacity of memory are explained. The achievements of methods for numerical weather prediction are proved by recent results. In U.S.A. and Sweden these numerical methods are already used for routine weather prediction.

59. H. Zemanek (Wien/Österreich)
Working on electronic computers and information processing apparatus at the Institut für Niederfrequenztechnik der Technischen Hochschule in Wien

In connection with the working schedule of the institute on pulsing techniques firstly problems raised regarding dimensioning of counting registers and then the development of a pulse counting device. Later on we began the construction of a computer the fixed program of which is based on the Galton board principle; for this purpose polycathode glow-discharge counting tubes were developed, but because of their instability the computer could not be completed.

The next model was an analogue computer for solution of equations up to the 6th order equipped with a step switch device for modification of variables. By this solutions may be found automatically to a certain degree.

For education purposes a simple model of a relay computer was constructed working with 16 memory cells for 18 binary digits and controlled by punched tape. In spite of a minimum of technical consumption the machine shows all features of a program sequence controlled computer.

Then we have built another relay computer for evaluation of logistic functions. Programming is carried out by means of plug-in cables and adjustment of variables either manually or automatically by running all possible combinations to find truth value 0 or 1 of the function.

A larger program sequence controlled computer shall be developed according to the moderate means at our disposal, using to a high degree transistors. A magnetic drum memory for 180,000 bits is under construction.

Moreover, we have copied the turtles of GREY WALTER using relays and a vocoder (recording only the spectrum of spoken language and thus reducing the band width to approximately one tenth). Further a computer is under construction automatically producing music-like sequences of sounds and thus having something like phantasy.

60. H. Zemanek (Wien/Osterreich)
The logistic relay computer of the Institut für Niederfrequenztechnik der Technischen Hochschule Wien

This computer is a further development of the apparatus built by Ferranti in England. It is distinguished by more compact assembly, technical construction (without rectifiers) and some auxiliary and safety devices. It has been completed as Diplomarbeit within the training schedule of our institute of technology.

In case of a logistic function it may be firstly asked for its value. For this purpose the function can be programmed at the machine by means of plug-in cables, variables can be adjusted; the computer indicates truth value.

Secondly it may be asked which values must be assumed by the variables that the function assumes a definite value (0 or 1). Therefore the computer automatically must run all possible combinations and indicate those corresponding with the conditions. An example has been carried out: 7 variables give 128 combinations — the running time for which is about 2 minutes without stop time. A secondary condition it may be required that only solutions with one or more figures of variables with the truth value 1 shall be indicated.

Thirdly it may be asked in which way a given logistic function may be realized with a minimum of technical consumption. Up to now, no computing machine is known which can solve this problem; however, a smaller computer of SHANNON and MOORE allows discovery and location of superfluous contacts.

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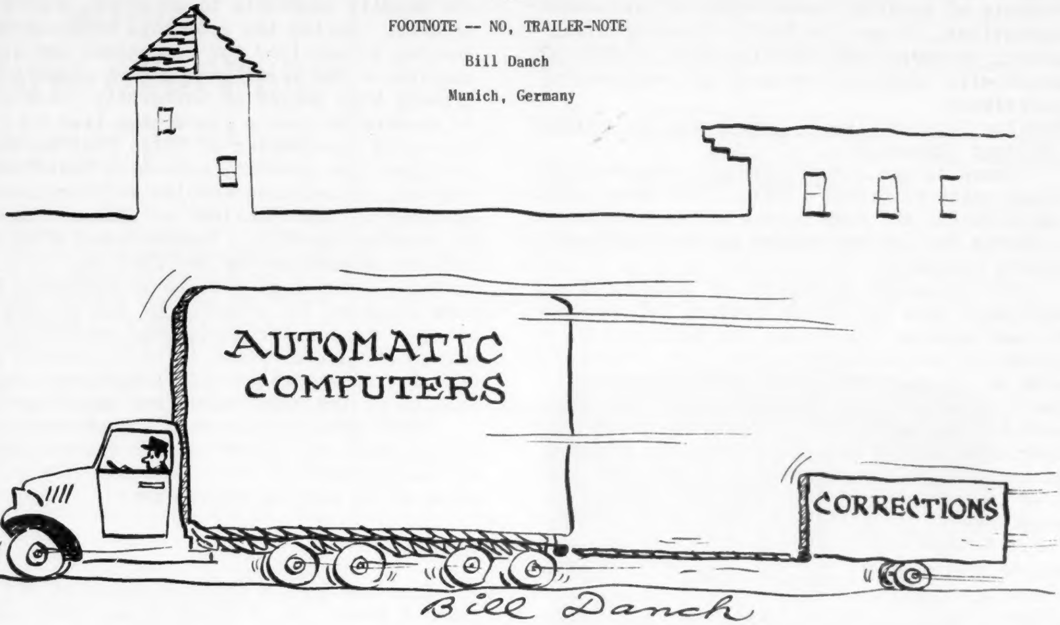
- END -

Forum

FOOTNOTE -- NO, TRAILER-NOTE

Bill Danch

Munich, Germany



(cont'd from page 11)

variety of problems encountered in government operations, it must be highly flexible in character. Moreover the facility will provide our staff with increased research and engineering experience.

Modular Construction of Electronic Equipment (Project Tinkertoy)

There is one other important example of work along quite different lines. This deals with our work for the Navy Bureau of Aeronautics on a system for the mechanized production of electronic equipment.

The extensive dependence of modern military equipment upon electronic devices led the Navy to seek ways of increasing its mobilization potential with a system which might eliminate some of the previously experienced difficulties. Important among these difficulties are such factors as (1) extreme dependence on many sources of supply for components which during periods of rapid expansion of production can lead to many bottlenecks, (2) long lead time necessary to get large-scale production lines for military equipment into operation, (3) high degree of variability in product performance characteristics, leading to extensive and complicated maintenance problems particularly for military equipment (various estimates give the maintenance costs of military electronic equipment as 5 to 100 times the initial cost), and (4) extensive dependence of production techniques on hand methods. It is a curious anomaly that this industry, whose products have been widely heralded as making possible automatic factories for other industries, is in its own production technique extensively dependent on manual labor. Basic design systems for the production of electronic equipment have changed very little since the mid-1920's, when the inverted cake pan type of chassis assembly was evolved.

The project consisted of two parts: first, the development of a modular system for the design of electronic equipment and, second,, the design of automatic machines for processing and assembling the components of the modular system. Solution of the first was considered essential to the successful completion of the second since early analysis led to the conclusion that any mechanized system which would assemble conventional components in conventional layouts would be unacceptably cumbersome and inflexible. The modular design system is based on a standard building block, a 7/8" square, notched ceramic wafer. Components such as resistors, capacitors, repetitive circuit elements and tube sockets are made integral with the ceramic building block. These are assembled in skyscraper-type structures yielding a standard module for each circuit stage. Devising circuit layouts by this approach involves planning in three dimensions rather than the conventional two dimensional approach heretofore employed. These standard building blocks and modules are readily adaptable to automatic machine methods. During the assembly, 100% automatic testing is provided for components and subassemblies. The resulting product shows an extremely high degree of uniformity. Flexibility is assured in that a production line can be converted in a matter of hours from building a civilian type product, such as a radio receiving set, to building complex military electronic equipment. This provides an unusual capability in standby capacity. Further proof of the flexibility is provided by the fact that a wide variety of types of electronic equipment have been designed for assembly by the modular technique. The modular design and assembly also afford an unusual possibility in standard packages for subassemblies with attendant simplification of the maintenance and repair problems.

These developments were turned over to industry about two years ago and several companies are now engaged in the production of electronic items using modular techniques.

Summary

This has been a long presentation on my part, I know. But I think it was necessary to give the members of this Committee a fairly complete history of the development and application of techniques in automation. If I may summarize now, I would make these points.

Automation is not new. It is the natural outgrowth of scientific research and development in the field of mechanization. It is new only in the sense that recent advances in the field of electronics and communication can now be applied to mechanization. And just as previous advances in mechanization have helped to further our civilization and to increase our productive capacity, so automation offers promises of even greater benefit. Automation makes use of the high-speed capabilities of electronic data-processing devices and computers. These new devices promise to serve society in several ways. They will be effective tools for increasing productivity and for production control. They will relieve considerably the massive paper-handling and processing problems of the Nation's businesses and offices. They will be high-speed servants for the efficient management of complex organizations, such as Government agencies. They offer to science and engineering a magnificent tool for undertaking scientific problems which were hitherto impossible because of the length of time required for solution.

These I think are the promises of these new machines. But I urge you to remember that this enlargement of our productive capacity comes about because of advances in mechanization which, in turn, are dependent upon an enlarged scientific program. As we grow, we become more and more complex. Continued research helps us to cope with this complexity.

– END –

NEW PATENTS

RAYMOND R. SKOLNICK
Reg. Patent Agent
Ford Instrument Co.
Div. of Sperry Rand Corp.
Long Island City 1, N.Y.

The following is a compilation of patents pertaining to computers and associated equipment from the Official Gazette of the United States Patent Office, dates of issue as indicated. Each entry consists of: patent number / inventor(s) / assignee / invention.

December 27, 1955: 2,728,524/-/John H. Neher, Wynnewood, Pa. / For use in an analog computer, a timing and testing circuit for determining temperature transients by electric analogy.

2,728,882 / Charles L. Cohen, Hyattsville, Md./ ACF Industries, Inc., N. J. / A computer stabilizing system.

2,728,886 / Nicholas Rohats, Scotia, N. Y. / General Electric Co., N. Y. / An electric control circuit.

2,728,887 / Stuart C. Rockafellow, Farmington, Mich. / Robotron Corp., Detroit, Mich. / A variable voltage rectifier system from a three-phase line source.

2,728,899 / Wayne M. Ross, Seattle, Wash. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. / A receiver blanking circuit for pulse transmission-reception systems.

2,728,900 / Wayne M. Ross, Seattle, Wash. / Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. / A pulse timer and receiver for automatic gain control in pulsed object-locating systems.

2,728,902 / Harry B. White, Canton, and Maurice D. Stahl and Jack E. Duff, North Canton, Ohio / U.S.A. / An apparatus for supersonic ranging and detection.

2,728,907 / Carl E. Grunsky, Garden City, N.Y./ Sperry Rand Corp., Del. / Servo systems for pulse signals.

January 3, 1956: 2,729,106 / James C. Mathiesen, Pleasantville, N. Y. / Norden-Ketay Corp., Ill. / An air-supported gyroscope.

2,729,107 / Frederick D. Braddon, Babylon, N. Y. / Sperry Rand Corp., Del. / A three axis gyroscopic reference instrument.

2,729,701 / Maurice Moise Levy, London, Eng. / The General Electric Co., Ltd., London, Eng. / An electric pulse code modulation system for periodically generating a group of coded pulses representative of the instantaneous value of a magnitude which may vary within a given range.

2,729,727 / Everett W. Molloy, South San Gabriel, and Harold R. Schultz, Anaheim, Calif. / Beckman Instruments, Inc., Fullerton, Calif. / A variable impedance device.

2,729,742 / Frederick N. Brauer, Jenkintown, Pa. / Philco Corp., Philadelphia, Pa. / A pulse-operated timing circuit.

2,729,772 / Corles M. Perkins / Minneapolis, Minn. / Bendix Aviation Corp., Teterboro, N. J. / A device for amplifying the usable signals and rejecting the spurious signals of a signal source which develops signal voltages in response to a change in a condition to be measured.

2,729,773 / Floyd G. Steele, La Jolla, Calif./ Digital Control Systems, Inc., Calif. / An electric motor control system employing di-function signals.

2,729,774 / Floyd G. Steele, La Jolla, Calif./ Digital Control Systems, Inc., Calif. / A di-function non-linear servo system.

2,729,781 / Roswell W. Gilbert, Montclair, N.J. / Weston Electrical Instrument Corp., Newark, N. J. / An electromagnetic transformer.

2,729,807 / John O. Paivinen, Aldan, Pa. / Burroughs Corp., Detroit, Mich. / A gate and memory circuit utilizing magetic cores.

2,729,808 / Isaac Levin Auerbach, Philadelphia, and John Oliver Paivinen, Aldan, Pa. / Burroughs Corp., Detroit, Mich. / Pulse gating circuits and methods.

2,729,809 / Robert G. Hester, Redondo Beach, Calif. / U.S.A. / A polarity selector.

2,729,811 / Paul Francois Marie Gloess, Paris, Fr. / Societe D'Electronique et d'Automatisme, Paris, Fr. / A method of electrically converting a number in a numeration system into a number of another numeration system of an order inferior to the first numeration system.

2,729,812 / Dale M. Jahn, Garden City, N.Y. / Sperry Rand Corp., Del. / An apparatus for converting digital information to an analog voltage.

January 10, 1956: 2,730,300 / Henry C. Savino, Hackensack, N. J./-/A computing and indicating system for showing deviations from a control unit.

2,730,301 / Bernard Delacour Beamish, New Rochelle, N. Y./-/An electric can counter circuit for counting objects moving along a common path.

2,730,568 / Leon H. Reagon, Richland, Wash. / General Dynamics Corp., Del. / A starting next idle register.

2,730,573 / Hugh Brougham Sedgfield, Barnes Common, London, and Frederick Arthur Summerlin, Lee, London, Eng. / The Sperry Gyroscope Co., Ltd., Brentford, Eng. ; A feed-back amplifier system and servo mechanism that is adapted to respond to input changes at very

(cont'd on page 42)

(cont'd from page 40)

low frequencies.

2,730,574 / Frederick H. Belsey, Sale, Eng. / General Electric Co., N.Y. / A multi-stage magnetic amplifier having a plurality of push-pull connected stages in cascaded connection.

2,730,576 / Robert S. Caruthers, Mountain Lakes, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A miniaturized transistor amplifier circuit.

2,730,617 / George H. Marmont, Hollywood, Calif., and Bernard M. Oliver, Morristown, N.J. / Bell Telephone Lab., Inc., New York, N.Y. / A timing circuit.

2,730,619 / William S. Parnell, Glen Burnie, and John W. Taylor, Jr., Baltimore, Md. / U.S.A. / An oscillator control.

2,730,620 / Otto H. Schmitt, Minneapolis, Minn., and Winfield E. Fromm, Roslyn, N.Y. / Airborne Instruments Lab., Inc., Mineola, N.Y. / A variable frequency signal generator.

2,730,624 / Alvin Hahnel, Little Silver, N.J. / U.S.A. / A frequency multiplier circuit.

2,730,632 / Daniel L. Curtis, Venice, Calif. / Hughes Aircraft Co., Del. / A diode gating circuit.

2,730,657 / Stuart C. Rockafellow, Farmington, Mich. / Robotron Corp., Detroit, Mich. / A multiple phase control system.

2,730,658 / Willem Six, Eindhoven, Neth. / Hartford National Bank and Trust Co., Hartford, Conn. / An apparatus for counting pulses.

2,730,676 / Ronald Hugh Barker, Christchurch, Eng. / National Research Development Corp., London, Eng. / A cyclic permuting pulse code system.

January 17, 1956: 2,731,199 / Ioino Ghertman and Edmund Febvrd, St. Mande, Fr. / International Business Machines Corp. / New York, N.Y. / A computing mechanism for checking computations.

2,731,200 / Albert C. Koelsch, Jr., Poughkeepsie, N.Y. / International Business Machines Corp., New York, N.Y. / A combined record sensing and storage system.

2,731,201 / Leonard R. Harper, Poughkeepsie, N.Y. / International Business Machines Corp., New York, N.Y. / An electronic counter comprising at least four bistable devices connected in cascade.

2,731,203 / James G. Miles, Minneapolis, Minn. / Sperry Rand Corp., Del. / A saturable core circuit for counting and the like.

2,731,519 / Robert W. Bordewieck, Southboro, Mass. / Moore Electronic Lab., Inc., Worcester, Mass. / A special low impedance output circuit for high chain bridge amplifier.

2,731,521 / Jack A. Crawford, China Lake, Calif. / U.S.A. / A magnetic amplifier.

2,731,571 / Button Chause, Cambridge, Mass. / U.S.A. / A delay circuit.

2,731,594 / Stuart C. Rockafellow, Farmington, Mich. / Robotron Corp., Detroit, Mich. / An apparatus for simultaneously shifting the phase of each phase circuit of a multiphase system.

2,731,595 / George R. Gamertsfelder, Watertown, Mass. / U.S.A. / A phase shifting circuit comprising an impedance network made up of resistance and inductive elements.

January 24, 1956: 2,732,497 / Robert D. Hancock, Compton, Calif. / Northrop Aircraft Inc., Hawthorne, Calif. / A pulse generator.

2,732,504 / Floyd G. Steele, Long Beach, Calif. / Northrop Aircraft, Inc., Hawthorne, Calif. / A linear cam computer.

2,732,505 / Alec Hervey Bennett Walker and Kenneth G. King, London, Eng. / Westinghouse Brake and Signal Co., Ltd., London, Eng. / An electric control apparatus.

2,732,520 / Georges Rene Covanault, Vitry-sur-Seine, Fr. / Societe Alsacienne de constructions Mecaniques, Paris, Fr. / An electrical servo-mechanism.

- END -

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BULK SUBSCRIPTION RATES

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SPECIAL ISSUES OF "COMPUTERS AND AUTOMATION"

The June issue of "Computers and Automation" commencing with June, 1955, is a special issue, "The Computer Directory."

For details about the next computer directory, see "The Computer Directory, 1956: tice."

COMPUTERS AND AUTOMATION — Back Copies

REFERENCE INFORMATION: (with notes regarding latest issues containing same)

Organizations:
- Roster of Organizations in the Computer Field (Dec. 1955)
- Roster of Computing Services (Dec. 1955)
- Roster of Consulting Services (June 1955)

Computing Machinery and Automation:
- Types of Automatic Computing Machinery (Dec. 1955)
- List of Automatic Computers (Feb. and April 1955)
- Outstanding Examples of Automation (July 1954)
- Commercial Automatic Computers (Dec. 1954)
- Types of Components of Automatic Computing Machinery (March 1955)

Products and Services in the Computer Field:
- Products and Services for Sale (June 1955)
- Classes of Products and Services (June 1955)

Words and Terms:
- Glossary of Terms and Expressions in the Computer Field (Jan. 1956)

Information and Publications:
- Books and Other Publications (many issues)
- New Patents (nearly every issue)
- Roster of Magazines (Dec. 1955)
- Titles and Abstracts of Papers Given at Meetings (many issues)

People:
- Who's Who in the Computer Field (June and Sept. 1955)

June: THE COMPUTER DIRECTORY, 1955 (164 pages):
- Part 1: Who's Who in the Computer Field
- Part 2: Roster of Organizations in the Computer Field
- Part 3: The Computer Field: Products and Services for Sale

July: Mathematics, the Schools, and the Oracle — Alston S. Householder
- The Application of Automatic Computing Equipment to Savings Bank Operations — R. Hunt Brown
- The Book Reviewer -- Rose Orente
- Linear Programming and Computers, Part I -- Chandler Davis

August: The Automation of Bank Check Processing -- R. Hunt Brown
- Linear Programming and Computers, Part II -- Chandler Davis
- Justifying the Use of an Automatic Computer -- Ned Chapin
- Charting on Automatic Data Processing Systems — Harry Eisenpress, James L. McPherson, and Julius Shiskin
- A Rotating Reading Head for Magnetic Tape and Wire -- National Bureau of Standards
- Some Curiosities of Binary Arithmetic Useful in Testing Binary Computers — Andrew D. Booth

September: A Big Inventory Problem and the IBM 702 -- Neil Macdonald
- Publications for Business on Automatic Computers: A Basic Listing -- Ned Chapin
- Franchise -- Isaac Asimov
- Automatic Coding for Digital Computers — G. M. Hopper
- Automatic Programming: The A-2 Compiler System — Part 1

October: The Brain and Learned Behavior -- Dr. Harry F. Harlow
- Automatic Programming: The A-2 Compiler System — Part 2
- Who Are Manning the New Computers? -- John M. Breen

November: Automatic Answering of Inquiries — L. E. Griffith
- Found: A "Lost" Moon — Dr. Paul Herget
- Mister Andrew Lloyd -- R. W. Wallace

December: Digital Computers in Eastern Europe -- Alston S. Householder
- Automatic Airways -- Henry T. Simmons

January, 1956: Machines and Religion — Elliot Gruenberg
- Automatic Coding Techniques for Business Data Processing: Directions of Development -- Charles W. Adams, Bruce Moncreiff
- What is a Computer? -- Neil D. Macdonald

February: The Function of Automatic Programming for Computers in Business Data Processing -- R. E. Rossheim
- Computers and Engineering Education — Paul E. Stanley
- The Planning Behind the IBM 702 Installation at Chrysler Corporation — Eugene Lindstrom

March: Organization of a Programming Library for a Digital Computer Center -- Werner L. Frank
- Growth of IBM Electronic Data-Processing Operations on the West Coast -- Neil D. Macdonald
- Translating Spoken English into Written Words -- E. C. Berkeley
- IBM Trust Suit Ended by Decree

BACK COPIES: Price, if available, $1.25 each, except June, 1955, $4.00. Vol. 1, no. 1, Sept. 1951, to vol. 1, no. 3, July, 1952: out of print. Vol. 1, no. 4, Oct. 1952: in print. Vol. 2, no. 1, Jan. 1953, to vol. 2, no. 9, Dec. 1953: in print, except March, no. 2, May, no. 4, and July, no. 5. Vol. 3, no. 1, Jan. 1954, to vol. 3, no. 10, Dec. 1954: in print. Vol. 4, 1955, no. 1 to 12, in print.

A subscription (see rates on page 4) may be specified to begin with the current month's or the preceding month's issue.

WRITE TO:

Berkeley Enterprises, Inc.
Publisher of COMPUTERS AND AUTOMATION
513 Avenue of the Americas
New York 11, N. Y.

ADVERTISING IN "COMPUTERS AND AUTOMATION"

Memorandum from Berkeley Enterprises, Inc.
Publisher of COMPUTERS AND AUTOMATION
513 Ave. of the Americas, New York 11, N.Y.

1. What is "COMPUTERS AND AUTOMATION"? It is a monthly magazine containing articles, papers, and reference information related to computing machinery, robots, automatic control, cybernetics, automation, etc. One important piece of reference information published is the "Roster of Organizations in the Field of Computers and Automation". The basic subscription rate is $5.50 a year in the United States. Single copies are $1.25, except June, 1955, "The Computer Directory" (164 pages, $4.00). For the titles of articles and papers in recent issues of the magazine, see the "Back Copies" page in this issue.

2. What is the circulation? The circulation includes 2000 subscribers (as of Feb. 10): over 300 purchasers of individual back copies; and an estimated 2500 nonsubscribing readers. The logical readers of COMPUTERS AND AUTOMATION are people concerned with the field of computers and automation. These include a great number of people who will make recommendations to their organizations about purchasing computing machinery, similar machinery, and components, and whose decisions may involve very substantial figures. The print order for the Apr. issue was 2700 copies. The overrun is largely held for eventual sale as back copies, and in the case of several issues the overrun has been exhausted through such sale.

3. What type of advertising does COMPUTERS AND AUTOMATION take? The purpose of the magazine is to be factual and to the point. For this purpose the kind of advertising wanted is the kind that answers questions factually. We recommend for the audience that we reach, that advertising be factual, useful, interesting, understandable, and new from issue to issue. We reserve the right not to accept advertising that does not meet our standards.

4. What are the specifications and cost of advertising? COMPUTERS AND AUTOMATION is published on pages 8½" x 11" (ad size, 7" x 10") and produced by photooffset, except that printed sheet advertising may be inserted and bound in with the magazine in most cases. The closing date for any issue is approximately the 10th of the month preceding. If possible, the company advertising should produce final copy. For photooffset, the copy should be exactly as desired, actual size, and assembled, and may include typing, writing, line drawing, printing, screened half tones, and any other copy that may be put under the photooffset camera without further preparation. Unscreened photographic prints and any other copy requiring additional preparation for photooffset should be furnished separately; it will be prepared, finished, and charged to the advertiser at small additional costs. In the case of printed inserts, a sufficient quantity for the issue should be shipped to our printer, address on request.

Display advertising is sold in units of a full page (ad size 7" x 10", basic rate, $190) two-thirds page (basic rate, $145), and half page (basic rate, $97); back cover, $370; inside front or back cover, $230. Extra for color red (full pages only and only in certain positions), 35%. Two-page printed insert (one sheet), $320; four-page printed insert (two sheets), $590. Classified advertising is sold by the word (60 cents a word) with a minimum of 20 words.

5. Who are our advertisers? Our advertisers in recent issues have included the following companies, among others:

- Aircraft-Marine Products, Inc.
- American Bosch Corp.
- Ampex Corp.
- Armour Research Foundation
- Arnold Engineering Co.
- Automatic Electric Co.
- Bendix Aviation Corp.
- Cambridge Thermionic Corp.
- Epsco, Inc.
- Ferranti Electric Co.
- Ferroxcube Corp. of America
- General Electric Co.
- Hughes Research and Development Lab.
- International Business Machines Corp.
- Lockheed Aircraft Corp.
- Lockheed Missile Systems
- Logistics Research, Inc.
- The Glenn L. Martin Co.
- Monrobot Corp.
- Norden-Ketay Corp.
- Northrop Aircraft, Inc.
- George A. Philbrick Researches, Inc.
- Potter Instrument Co.
- Ramo-Wooldridge Corp.
- Reeves Instrument Co.
- Remington Rand, Inc.
- Republic Aviation Corp.
- Sprague Electric Co.
- Sylvania Electric Products, Inc.

PUBLICATIONS

P 34; LINEAR PROGRAMMING AND COMPUTERS. Reprint of two articles by Chandler Davis, in July and August 1955 "Computers and Automation". A clear, well-written introduction to linear programming, with emphasis on the ideas. $1.20

P 2D: THE COMPUTER DIRECTORY, 1955. 164 pages, 7500 Who's Who entries, 300 Organization entries, and 600 entries of Products and Services for Sale in the Computer Field; 250,000 words of condensed factual information about the computer field, June 1955 issue of "Computers and Automation." $4.00

P 32: SYMBOLIC LOGIC, by LEWIS CARROLL. Reprint of "Symbolic Logic, Part I, Elementary," 4th edition, 1897, 240 pages, by Lewis Carroll (C. L. Dodgson). Contains Lewis Carroll's inimitable and entertaining problems in symbolic logic, his method of solution (now partly out of date), and his sketches of Parts II and III, which he never wrote since he died in 1898. ....$2.50

P 25: NUMBLES -- NUMBER PUZZLES FOR NIMBLE MINDS. Report. Contains collection of puzzles like:

	TRY	HAVE	and TRAIN
+	THESE	FUN	your . WITS
=	TWVAS	WASE	ENTNS

WYE = VIF

In fact, you can also: 90893 85202 44393 29081 (Solve for the digits -- each letter stands for just one digit 0 to 9)
All are new numbles, additions, multiplications, etc.; some easy, some hard. Each with two messages, one open, one hidden. Hints for solution. Good exercises in logical reasoning. $1.00

--------MAIL THIS COUPON----------
or copy it

Edmund C. Berkeley and Associates,
815 Washington St., R156
Newtonville 60, Mass.

Please send me publications circled and your announcement of publications:

2D 25 32 34

I enclose $________ in full payment. (Add 10¢ per item to cover cost of handling and mailing.) It is understood that if I am not satisfied, I may return any item within five days after receiving it, and you will at once refund my money. My name and address are attached.

ADVERTISING INDEX

The purpose of COMPUTERS AND AUTOMATION is to be factual, useful, and understandable. For this purpose, the kind of advertising we desire to publish is the kind that answers questions, such as: What are your products? What are your services: And for each product, What is it called? What does it do? How well does it work? What are its main specifications?

Following is the index and a summary of advertisements. Each item contains: Name and address of the advertiser / subject of the advertisement / page number where it appears / CA number in case of inquiry (see note below).

Ampex Corporation, 934 Charter St., Redwood City, Calif. / Digital Magnetic Tape Transport / Page 49 / CA No. 110

Arma Division, American Bosch Arma Corp., Roosevelt Field, Garden City, L.I., N.Y. / Engi- Opportunities / Page 43 / CA No. 111

Arnold Engineering Co., Marengo, Ill. / Bobbin Cores / Page 5 / CA No. 112

Berkeley Enterprises, Inc., 513 Ave. of the Americas New York 11, N.Y. / Robot Show Stoppers, Geniac Kit Publications / Pages 39 41, 47 / CA No. 113

Cambridge Thermionic Corp., 447 Concord Ave., Cambridge 38, Mass. / Computer Components / Page 2 / CA No. 114

Computers and Automation, 513 Ave. of the Americas New York 11, N.Y. / Back Copies, Advertising / Pages 44, 46 / CA No. 115

Cudahy Publishing Co., 6141 N. Cicero Ave., Chicago, Ill. / Automatic Data Processing Service / Pages 25, 26 / CA No. 116

Electrodata Corporation, Pasadena, Calif. / Applications Specialists / Page 36 / CA No. 117

Ferranti Electric Inc., 30 Rockefeller Plaza, New York 20, N.Y. / High Speed Tape Reader / Page 47 / CA No. 118

Ferroxcube Corp., East Bridge St., Saugerties, N.Y. / Magnetic Core Materials / Page 31 / CA No. 119

General Electric Co., Aircraft Products Dept., 600 Main Street, Johnson City, N.Y. / Help Wanted / Page 43 / CA No. 120

General Electric Co., (Hanford Atomic Products), Richland, Washington / Help Wanted / Page 37 / CA No. 121

Hughes Research and Development Laboratories, Culver City, Calif. / Employment Opportunities / Page 39 / CA No. 122

Lockheed Aircraft Corp., California Div., Burbank, Calif. / Mathematical Analysts Wanted / Page 45 / CA No. 123

National Cash Register Co., Electronics Div., 3348 W. El Segundo Blvd., Hawthorne, Calif. / Digital Computer Engineers / Page 41 / CA No. 124

R.C.A. Service Co., Inc., Missile Test Project, P.O. Box 1226, Melbourne, Fla. / Help Wanted / Page 31 / CA No. 125

Sylvania Electric Products, Inc., 175 Great Arrow Ave., Buffalo 7, N.Y. / Matched Transistors / Page 50 / CA No. 126

READER'S INQUIRY

If you wish more information about any products or services mentioned in one or more of these advertisements, you may circle the appropriate CA Nos. on the Reader's Inquiry Form below and send that form to us (we pay postage; see the instructions). We shall then forward your inquiries, and you will hear from the advertisers direct. If you do not wish to tear the magazine, just drop us a line on a postcard.

READER'S INQUIRY FORM

Paste label on envelope: ↓ Enclose form in envelope: ↓

BUSINESS REPLY LABEL
NO POSTAGE STAMP NECESSARY IF MAILED IN

4¢ Postage Will Be Paid By --

BERKELEY ENTERPRISES, INC.
513 Ave. of the Americas
New York 11, N. Y.

FIRST CLASS
PERMIT NO 1680
Sec. 34.9, P. L. & R.
NEW YORK, N. Y.

READER'S INQUIRY FORM

Name (please print) ....

Your Address? ....

Your Organization? ....

Its Address? ....

Your Title? ....

Please send me additional information on the following subjects for which I have circled the CA number:

1 2 3 4 5 26 27 28 29 30 51 52 53 54 55 76 77 78 79 80 101 102 103 104 105 126 127 128 129 130
6 7 8 9 10 31 32 33 34 35 56 57 58 59 60 81 82 83 84 85 106 107 108 109 110 131 132 133 134 135
11 12 13 14 15 36 37 38 39 40 61 62 63 64 65 86 87 88 89 90 111 112 113 114 115 136 137 138 139 140
16 17 18 19 20 41 42 43 44 45 66 67 68 69 70 91 92 93 94 95 116 117 118 119 120 141 142 143 144 145
21 22 23 24 25 46 47 48 49 50 71 72 73 74 75 96 97 98 99 100 121 122 123 124 125 146 147 148 149 150

REMARKS:

new digital magnetic tape transport →

the **AMPEX FR200** for digital handling provides new performance standards, new convenience features and an unmatched excellence of design

NEW EASE OF TAPE CHANGE...
The time saving feature of single loop threading is provided by a lever which moves the idlers into a straight line. This arrangement eliminates chance of faulty threading by unskilled personnel.

NEW MACHINE-TO-MACHINE TAPE COMPATIBILITY...
All Ampex FR200 Tape Transports are manufactured to exact standards that permit tapes recorded on one to be reproduced on any other. Ampex-to-Ampex compatibility is guaranteed — *and at no extra cost.*

NEW PLUG-IN HEADS TO MATCH OTHER TAPE TRANSPORTS...
The Ampex FR200 uses self aligning plug-in head assemblies. These can be furnished to match other digital or analog tape recorders to permit tape interchange. A second head stack for monitoring or "off-tape" parity checking can also be added if desired.

HIGH-SPEED START AND STOP...
On the Ampex FR200 the tape attains full speed or full stop within less than 5 milliseconds to provide high information storage density. A remote control provision is provided, as well as pushbuttons on the topplate.

NEW STANDARD OF EXCELLENCE...
The FR200 brings to digital applications the reliability, durability and adherence to specification that have made Ampex Tape Recorders the most widely used in instrumentation.

NEW LOW PRICES BEGINNING AT $2675
The base price of $2675 is for a complete FR207-TB tape transport, with 7-track head, for ½-inch tape operating at 30 ips tape speed. Prices will be quoted on machines with other tape speeds, multiple speeds, other tape widths and other heads.

FULL SPECIFICATIONS ON THE FR200 *and description of its features and accessories are given in descriptive literature. For your copy, write Dept. VV-2539*

AMPEX
CORPORATION

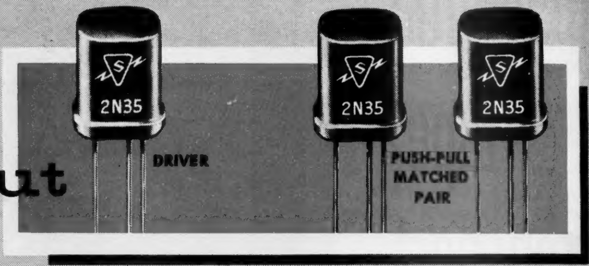
934 CHARTER STREET
REDWOOD CITY,
CALIFORNIA

DISTRICT OFFICES: New York; Chicago; Atlanta; Dayton; Redwood City; Silver Spring, Maryland (Washington D.C. Area)
DISTRIBUTORS: Radio Shack, Boston; Bing Crosby Enterprises, Los Angeles; Southwestern Engineering & Equipment, Dallas and Houston; Ampex-American in Canada.

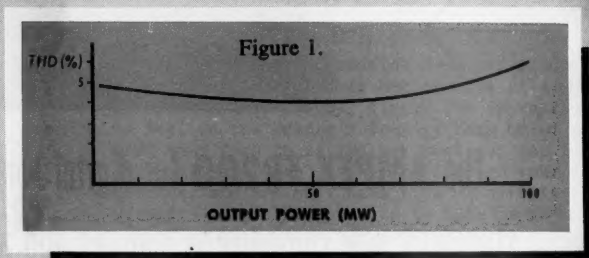
Sylvania NPN transistors

MATCHED

for high audio output



with low distortion



Whatever the front-end design in your transistor audio circuits, Sylvania offers a highly efficient audio transistor line-up for driver and push-pull stages. Controlled driver characteristics and a matched push-pull pair assure maximum power output with minimum distortion.

DRIVER STAGE

Sylvania's 2N35 for Class-A driver use has linear characteristics at high current levels, thereby insuring maximum input to the push-pull stage with minimum distortion.

PUSH-PULL MATCHED PAIR

Output transistors in Sylvania's audio line-up are matched to within 10% on collector current characteristics. The close tolerances to which the 2N35 push-pull pair is produced permit maximum power gain with minimum distortion as plotted in Figure 1.

Power output of the 2N35 pair is rated for a minimum of 100 mw at 50°C. Dissipation is rated at 50 mw, per unit, with higher rated counterparts available.

The all-important facilities — Sylvania is equipped to supply you with production quantities, so why not call your Sylvania Representative for samples. Or write for complete data. Address dept. D20R.

SYLVANIA®

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GY